

The Tangled Web We Weave:

Investigating the Barriers to Change in Plastic Recycling Policy
Development

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Thesis for the fulfilment of the
Master of Science in Environmental Management and Policy
Lund, Sweden, May 2021



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Published in 2021 by IIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
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ISSN 1401-9191

Acknowledgements

I want to start by thanking the interviewees who generously gave their time, their thoughts, and their vision. I learned so much by speaking with you, and it was such a joy to hear your insights. Your dedication towards making this tangled, phenomenal world of waste management better and help the planet shine through in every conversation, and I am so grateful you took the time to share it with me.

Thank you Leonidas for your guidance and your unwavering encouragement at every turn. Your advice helped me shape my work to be something I am truly proud of, and my conclusions are so much stronger from your thoughts. I could not have asked for a better supervisor.

To the staff at the Institute, thank you for creating an environment built so entirely around kindness and support. Even at the most difficult moments it felt like I could not fail because of the net of support you held beneath us. I feel so lucky to have found myself in a place of such care, that loves the pursuit of knowledge so deeply but even more so loves the people it brings into its fold. You have my endless gratitude for allowing me to be a part of that community.

To my wonderful batch, my team, thank you for being everything that you are. I adore all of you and knowing you have my back makes me feel ready to take on whatever comes next. I will miss you all terribly, but I cannot wait to see what we can do together, and I am so proud to see what we have achieved. To my walking buddies, Xana, Wanda, and Megan, thank you for wandering the flower fields with me, talking through tough problems big and small, and giving me excuses to enjoy the sunshine with good company. What a joy it was to watch the winter turn to spring with you.

Finally, to my family and to my friends, without whom I could never have weathered this great adventure and who, despite being over 4,000 miles away across an ocean, always felt close by. Mom, Dad, Emily, Papa, and of course Alice thank you for always having my back and always believing in me. Thank you for taking my panicked phone calls, for sharing my victories and pictures of spring. I would be nothing of what I am without you, and I love you with all of my heart. To my friends back home, thank you for your unwavering support and good humor, for waking up in the morning so we could talk before I went to bed, for sharing games and jokes and endless care, I am so much better for having you with me.

This past year has been an intense challenge, but it also has in many ways been a great gift and that is due almost entirely to the people who have been a part of this journey. Thank you, from the bottom of my heart, here's to the next great adventure to come.

Abstract

At the core of the sustainable solid waste management challenge lies increasing rates of consumption which contribute directly to problems of resource extraction and degradation. Recycling is a tool designed in part to address this problem of scarcity, however on its own it is not enough to solve the problem, particularly in relation to plastics, which are challenging to manage and often are not recycled well or at all. Yet recycling persists as the solution of choice when managing plastic material in many instances, despite knowledge of its limitations. This research examines what holds policy and strategy makers in the Pacific Northwest back from making changes to plastic recycling policy when it is found to be inadequate. The Pacific Northwest acts as a case study in this instance due to its position as a pioneer in recycling and waste policy and its potential for progressive change in the field. Two theories are analyzed to build the frame for the research: lock-in theory as a way to contextualize the external barriers to change and the sunk cost fallacy as a way to examine the internal ones. This theoretical analysis, along with regional strategy documents and insights obtained from interviews with individuals who work in or engage with policy and strategy development in the solid waste domain, were utilized to build a framework to map how these barriers manifest. This research provides an overview of these significant barriers, both internal and external, that limit the development away from unsuccessful plastic recycling strategy, how these barriers may overlap, and how they may amplify one another in feedback loops that increase their durability. To support future research and application, feedback loop mapping samples and opportunities for application in other regions and for other solid waste management strategies are outlined.

Keywords: Plastic Recycling, Policy Change Barriers, Strategy Change Barriers, Lock-In, Sunk Cost Fallacy

Executive Summary

Problem Definition

As human consumption increases, exemplified by the annually tightening Earth Overshoot window, natural resource consumption, degradation, and scarcity are fast becoming pressing issues (Past Earth Overshoot Days, 2021). Alongside this issue is an increasing generation of waste, a stream of materials that in many instances could either be reduced or repurposed to decrease the consumption of virgin materials and natural resources. One strategy that is often engaged with to address this challenge is recycling, which is intended to result in the repurposing of materials by re-integrating their contents into products that otherwise would have consumed more virgin materials in their production, a clear sustainable strategy. However, with plastic materials, this strategy is not always the best choice, and often can fall short of its sustainable promise.

Plastic recycling tends to reach its limits in a few key ways, the first of which is in the limited effectiveness in the practice. This refers to a few key struggles, the first of which is that many plastics cannot be recycled, despite society's belief and the fact they are collected as such. This may be because they cannot be sorted effectively, cannot be processed cleanly, or there is not enough of a market to manage lower grade plastic materials, and it limits the effectiveness of plastic recycling in many instances (MacBride, 2012). The second efficacy challenge is that plastic recycling very often does not mean a plastic product is repurposed into the same item it was before it was recycled. Commonly referred to as *downcycling*, many types of recyclable plastics are instead very often transformed into materials that normally would not be made of plastic at all, such as a bench, leading to the continued use of virgin material use for plastic items (Seattle's Solid Waste Management Plan, 2013). While there is value still in this process, in making sure these materials do not go to waste, it is a less sustainable process than reuse, reduction, or repair.

This becomes particularly significant when recycling is used as moral substitution for more desirable sustainable behaviors. In many cases, when people have the option of recycling, they may be less likely to pursue more desirable, difficult sustainable acts. This is the second key limitation, referred to as moral licensing. Because recycling is a less sustainable behavior than other materials management practices, its proliferation as the morally right thing to do in a societal context can lead to over-reliance on the practice, undercutting its sustainable goal.

Despite these failings, recycling-first strategy design for plastics is often prioritized, even in areas where it is found to be an insufficient solution. Frequently, a decision to maintain the status quo is made, even when it is shown that this status quo does not meet the higher sustainable goals of the waste management system. This is the problem this research seeks to address, using Seattle, Washington and Portland, Oregon, two cities located in the Pacific Northwest of the United States, as the regional focus for this study due to their regional similarities and influence on the broader US, particularly in relation to sustainable waste management practices.

Research Aim and Methods

In order to understand what causes the existing entrenchments in plastic recycling policy and strategy, this thesis sought to understand, synthesize, and convey a holistic understanding of the internal and external barriers that restrict necessary plastic recycling policy and strategy change. 'External Barriers' refers to limitations existing outside those responsible for policy or strategy implementation, such as societal or structural factors. 'Internal Barriers' refers to personal motivations or values that may influence strategic decision making, both of which are posited to have influence in this issue. If it is known that recycling cannot adequately manage the plastic generated by society in the region of focus, why is innovation not prioritized, and what causes policy and strategy makers to double down on solutions that are not working to meet their end goals? This research was conducted using two primary research questions as a guide:

RQ1: What are the interrelations between the sunk cost fallacy and lock-in theory and why do they influence decision making in relation to plastic recycling policy and strategic development?

Two theories were examined to answer this research question. Sunk cost, defined as a “heightened tendency to continue a project if money, time, or effort has been invested”, was the initial frame to contextualize Internal Barriers, though results deviated from its structure during research implementation (Arkes & Blumer, 1985, p.124). Lock-in, utilized to categorize External Barriers, is defined as the system of networks that locks actors into webs of policies, technologies, physical infrastructures, and cultural norms, restricting innovation potential, with four subcategories identified as institutional, technical, cultural, and material (Corvellec et al., 2012). These are utilized as the primary categorization frame for these barriers in the study.

RQ2: How do internal and external barriers restrict the development of innovative waste management strategies away from plastic recycling systems?

This research question was addressed largely through the interview process. *Figure I* provides an overview of how interview questions were formulated with the research questions as guideposts.



Figure I - Data Gathering Map for Interviews

Once interviews were conducted, they were retroductively integrated alongside examined literature and regional strategy documents to build an analysis framework to act as a categorization map and examination tool for the barriers identified by interviewees.

Findings and Results

The interview process yielded 95 codes, 52 of them either Internal or External Barriers that restrict development away from needed policy or strategy change. Of these barriers, 32 were External Barriers and 20 were Internal Barriers. Of these, several barriers stood out as the most commonly mentioned by interviewees. For External Barriers, the foremost four barriers identified by percent of interviewees mentioned were: limits of *Funding and Expense* (91%); the limits imposed by established *Infrastructure* (82%); the *Limited Influence* of regional solid waste policy or strategy makers (73%); and existing *Public Knowledge* in relation to sustainable waste practices (73%). For Internal Barriers, the foremost three highlighted were: the challenge that *Recycling is Needed* alongside changes and the grey area that creates (64%); the perception that recycling is “*The Right Thing to Do*” which restricts the motivation to pursue change (64%); and the narrow focus of recycling limiting examination of the big picture, codified as *Can’t See the Forest for the Trees* (55%).

One additional data set was collected in this study- instances where barriers *overlapped* between the internal and external realms. In the case of this research, this overlap was found in five distinct groups, exemplified in *Figure II*.

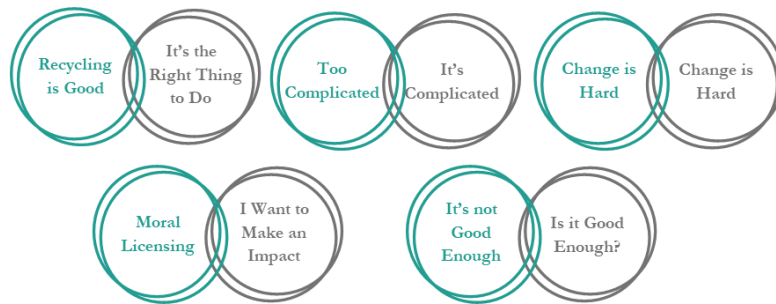


Figure II - Overlapping Barriers between Internal and External Domains

This overlap has been identified to be a potentially critical challenge, and an especially difficult set of barriers to break. When both the policy or strategy maker *and* society hold resistance, change can be especially difficult to achieve.

Conclusions and Recommendations

The results of this study have been found to be applicable in two key ways, the first of which is in their replicability. Using the barriers and codes identified in this study, and with additional supplemental regional or issue specific research, this process could be applied to other regions or waste systems experiencing the same entrenchment issues.

Once barriers are understood and identified, as a way to contextualize them more clearly and understand how they may influence one another, barriers can be integrated into a feedback loop map, exemplified in *Figure III*.

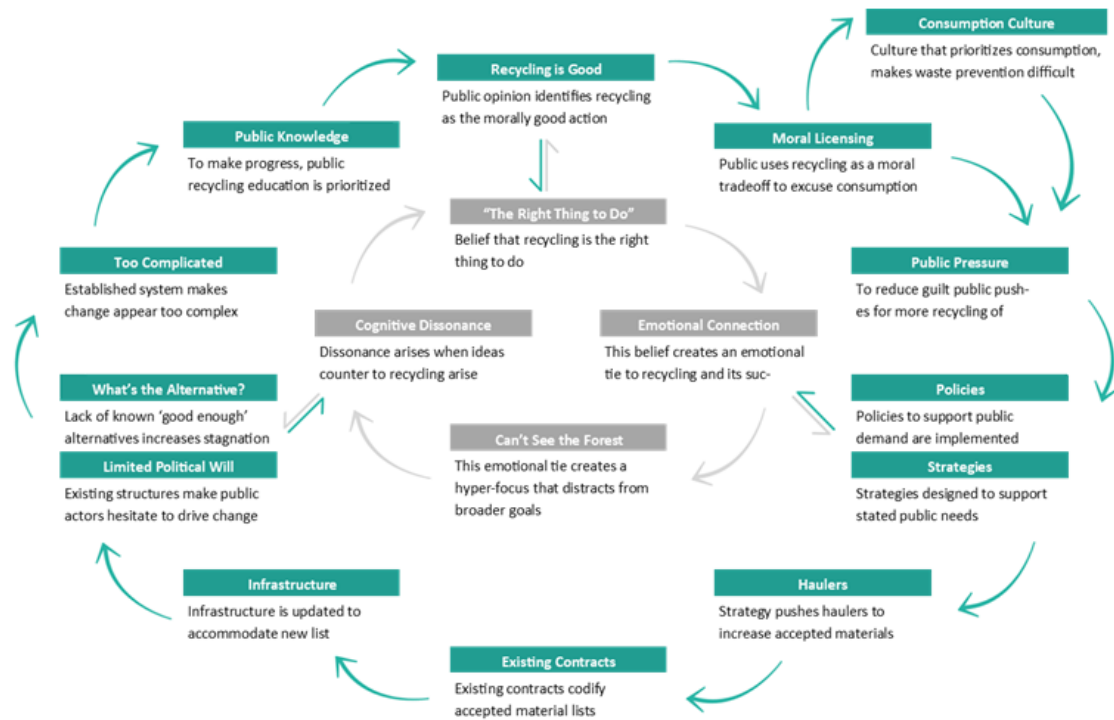


Figure III- Feedback Loop Map Sample Using Identified Barriers

There is an impulse to try and simplify these challenges into single issues, like “public knowledge” or “sorting improvements,” however if the factors that amplify those barriers are not understood and potentially addressed, barriers are likely to persist. Understanding the nuance and complication of the interacting web of barriers, both internal and external, can help open conversation and understanding on how to address entrenched systems and move towards more integrative waste management structures. This research acts to help provide a map for one of those systems, to support the conversations and development needed to reach the larger goals of sustainability this industry strives to achieve.

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Abbreviations

ACC: American Chemistry Council

AOR: Association of Oregon Recyclers

DEQ: Department of Environmental Quality, Oregon

EPA: Environmental Protection Agency

EPR: Extended Producer Responsibility

MRF: Material Recovery Facility

MSW: Municipal Solid Waste

OR: Oregon State

PCR: Post-Consumer Resin

PRO: Producer Responsibility Organization

PSI: Product Stewardship Instituted

RCRA: Resource Conservation and Recovery Act

SMM: Sustainable Materials Management

SPU: Seattle Public Utilities

US: United States

WA: Washington State

WSRA: Washington State Recycling Association

1 Introduction

In 2019, ‘Earth Overshoot Day’, or the day that the global human population consumption of resources exceeded what the Earth can naturally regenerate in the next year, was in mid-July (Past Earth Overshoot Days, 2021). In the past fifty years, the point in the year where this overshoot day is hit is steadily decreasing, from December in 1970 to October in 1986, to August in 2005, and though in 2020 the date pushed to August due to decreased consumption related to the global coronavirus pandemic, this trend shows little sign of improving long term (Past Earth Overshoot Days, 2021). With this increase in consumption patterns, alongside an increase in global population in regions with high consumption habits, some estimates suggest that by 2050 approximately three planets’ worth of annually regenerated resources will be needed to sustain human society (12—Ensure Sustainable Consumption and Production Patterns, 2020). With this trend comes the concern that, should the planet be unable to restore what is consumed, eventually what is consumed will run out.

These concerns around resource degradation and scarcity are a crucial piece of the environmental challenges being faced, and intrinsically related to that challenge is the management of waste. As patterns of consumption rise so too do waste generation patterns, daily urban waste generation between 1990 and 2000 increased by 2.7 million tons and is only projected to increase as urban populations rise (Raghu & Rodrigues, 2020). This is true for many materials, but one particularly notable material this trend has been observed with is plastic goods. Globally, plastic production increased by approximately 78% between 2000 and 2015, with a clearly increasing trend represented in *Figure 1-1* below.

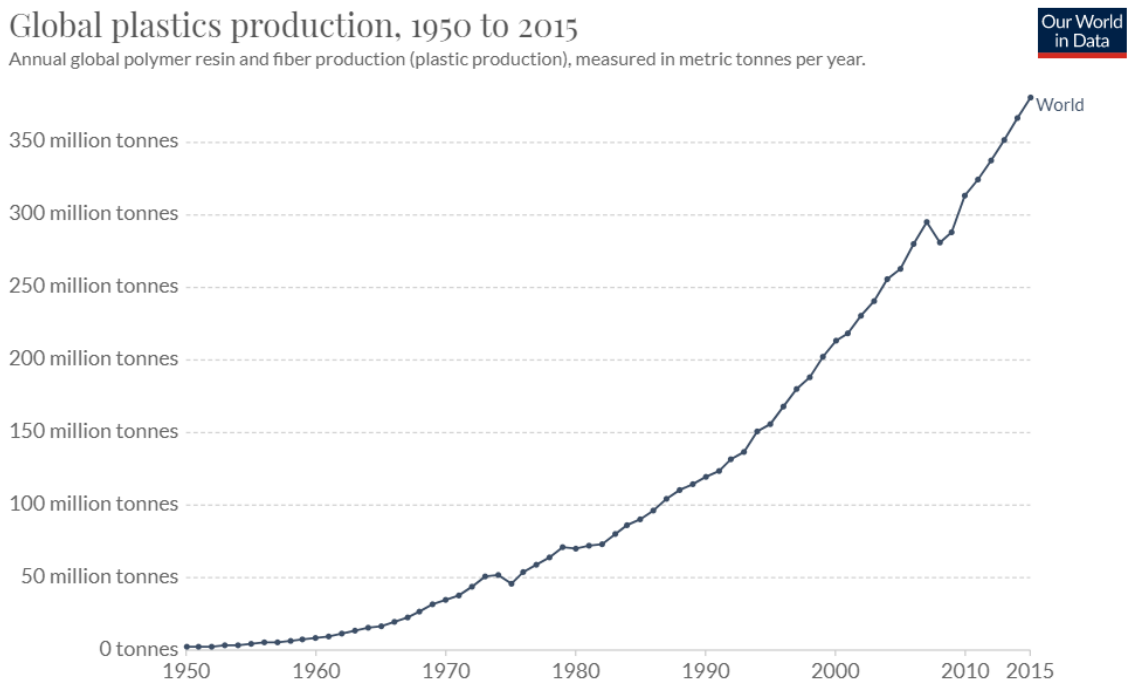


Figure 1-1. Trend of Global Plastic Production between 1950 - 2015

Source: Plastic Pollution, 2018

In the US alone, according to the US EPA, a similar trend can be seen, with plastic generation waste rising from 25,550 tons annually in 2000 to 35,680 tons in 2018. This trend can be observed more fully in *Figure 1-2* below.

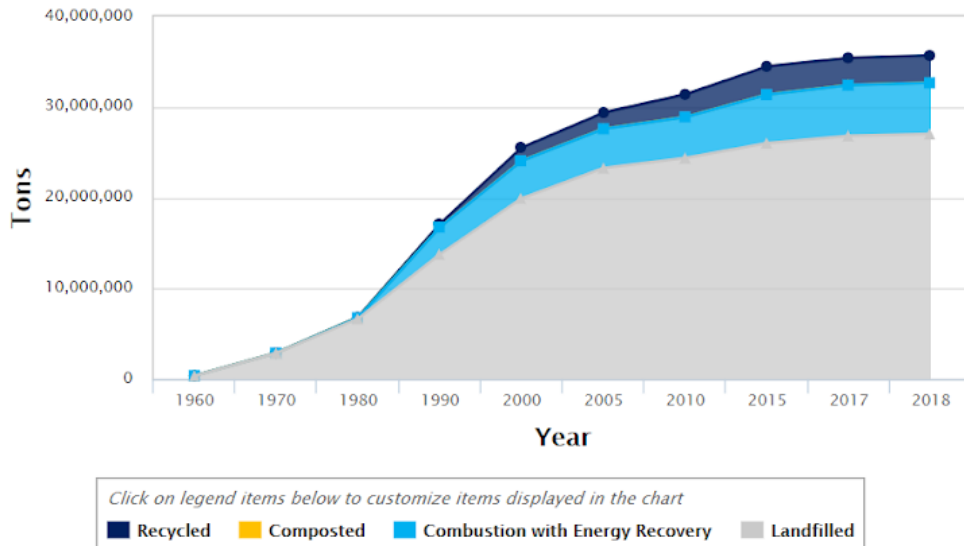


Figure 1-2. Trend of Plastic Generation Waste in the US between 1960 - 2018
 Source: *Plastics: Material Specific Data, 2020*

With these increasing trends in consumption and waste, crafting innovative management solutions of those waste materials is key. Repurposing and reusing materials in the waste stream can help decrease the levels of virgin material consumption and pairing those practices with waste reduction policies would help address the looming consequences of resource scarcity. However, despite this need for innovative solutions, waste policy in many instances maintains the status quo, prioritizing strategies like waste to energy and recycling in policy development over solutions that reach further up the waste hierarchy and are more able to address this rapidly increasing concern.

1.1 Problem Definition

There are of course many available options for how to manage waste, ranging from landfill to waste to energy, from recycling to composting and several solutions in between. However, many current waste practices have limited impact on the problem of consumption and resource degradation, and indeed some of the most relied upon strategies like recycling and waste to energy may significantly downcycle the quality of the product being processed depending on the material. Downcycling refers to the repurposing a recycled good for a lower value use than its initial purpose (Seattle’s Solid Waste Management Plan, 2013).

Downcycling can occur for many different reasons- in cases where hard to sort materials are combined they may be recycled into lower quality options like car parts or road filler, or in cases like waste to energy where good recycling methods do not exist so waste is burned to extract some additional value from the good as opposed to the prolonged storage and management required from landfilling that same good. However, a large challenge with downcycling practices is that a downcycled product cannot replace the original good, and as such the production of that good from virgin materials is likely to continue. It is important to highlight that recycling is a vital part of the materials management system and has a proven sustainable benefit, however it cannot *replace* more sustainable solutions like reduction, repair, and reuse, instead providing limited solutions to match a rising environmental crisis.

Plastics are particularly subject to this challenge “due to their physical properties, including high complexity and heterogeneity” which increases the difficulty of treatment (Murphy & Pincetl, 2013). A plastic good may consist of one of hundreds of resin structures, and any number of physical characteristics and rigidities, meaning “each is distinct in terms of recyclability”

(Murphy & Pincetl, 2013, p.43). The necessary reuse and recycling of depleted resources is therefore not appropriately achieved with the current system, particularly with the evolving complexity of generated waste materials.

However, despite this understanding of the limited efficacy of plastic recycling, it continues to be the sustainable strategy of choice in many waste systems. While some states are incorporating zero waste and waste reduction initiatives into their policy structures, those initiatives are still vastly outnumbered by recycling-based initiatives (Murphy & Pincetl, 2013). This seems to be in a large part due to the fact that recycling is a 'locked-in' system, part of an intricate web of industry networks and societal structures that restricts system development to a limited development path (Corvellec, Campos, and Zapata, 2012, p.33). There are many elements that seem to entrench this lock-in: from the fact that diversion targets and tracking systems were standardized decades ago and now act as a default model of success; to the development of expensive sorting infrastructure to support recycling initiatives that now appears wasteful to abandon or scale back on; to the way that public values and relies upon recycling as a sustainable option (Sullivan, 2020; Tierney, 1996). Elements like these create a complex web that propels policy strategies towards the recycling solution and are so thoroughly interconnected and entrenched that they pose a high challenge to circumvent.

With this web in place, coupled with what has been categorized as a desire in policy and strategy makers not to waste the investments already made on recycling policies and infrastructures in place, also defined in behavioral economics as 'sunk cost bias', this dedication to recycling as a strategy seems challenging to break. Sociological structures, economic barriers, political systems, and psychological entrenchment all combine to create an interdisciplinary set of challenges that require an interdisciplinary approach to assess. While theories like lock-in and sunk cost have been considered on their own, and applied effectively to recycling systems, limited research has been done to evaluate how they intersect and how internal and external barriers combine in the policy and strategy making sphere. It is in this domain where better understanding must be obtained, to adequately represent the nuance and complexity of this web and how it may be addressed to move towards more innovative sustainable policy.

1.2 Aim and Research Questions

In order to address the outlined problem, the aim of this thesis is to understand, synthesize, and convey a holistic understanding of the barriers to change that restrict necessary waste management policy and strategy change, using plastic recycling as an inroad to understand this phenomenon. If it is known that recycling cannot adequately manage the plastic generated by society in the region of focus, why is innovation not prioritized, and what causes policy and strategy makers to double down on solutions that are not working to meet their end goals?

Lock-in and the sunk cost fallacy were selected as the primary theories to be used to investigate this phenomenon for two reasons. The first being that each has been applied to waste management research well in the past, creating a strong framework backing that can be used in this context. Lock-in is most commonly investigated in relation to carbon but has been applied to waste extensively by Corvellec et al. (2012), who provide a strong case for waste lock-in. Sunk cost is more expansively studied in relation to individual and household behavior, but extensive evidence of how sunk cost manifests in relation to different forms of recycling behavior has been found and can be well adapted to the individual policy or strategy maker perspective in this context (Raghu & Rodrigues, 2020; Walton, 2002). These theories combined additionally provide an interesting complementary perspective, providing an assessment of both the internal, individual barriers that may restrict policy and strategy makers alongside external, system-based pressures.

While studies exist outlining how lock-in or sunk cost may be an explanation, very little research examining how the *combination* of these factors, internal and external, may be acting as a more complicated and critical barrier to change. As such, two key research questions have been identified to assist this aim:

RQ1: What are the interrelations between the sunk cost fallacy and lock-in theory and why do they influence decision making in relation to plastic recycling policy and strategic development?

RQ2: How do internal and external barriers restrict the development of innovative waste management strategies away from plastic recycling systems?

1.3 Scope

The scope of this study has been narrowed in three key areas: (1) region of focus; (2) sector of analysis; and (3) material stream.

1.3.1 Region of Focus

The region of focus has been identified as the United States of America with a specific analysis lens on the states of Washington, and Oregon. The United States was selected primarily as it is estimated to be one of the largest waste generators in the world, with per capita generation in the top 12% of countries, and as such it is a valuable target in the mission to improve waste management practices and resource recovery (Hoorweg & Bhada-Tata, 2012).

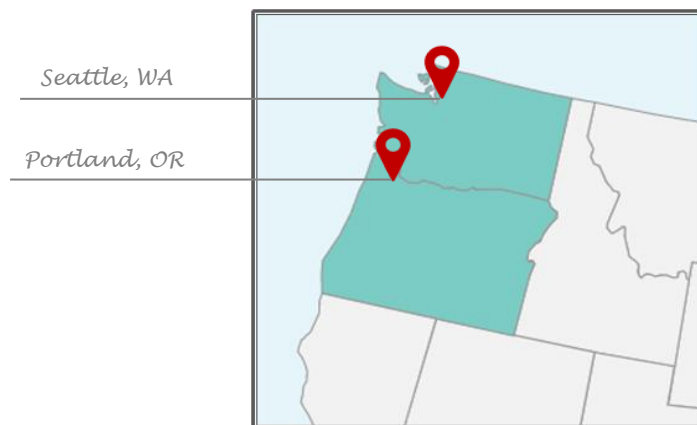


Figure 1-3. Highlighted Region of Focus – Washington and Oregon State
Source: United States, 2021

Two key cities were selected for examination to ensure focused, comparative results could be provided: (1) Seattle, Washington and (2) Portland, Oregon. These cities were selected for a few key reasons.

The first factor guiding selection is influence. The western coast of the United States has acted as one of the key influence centers in the US for a good deal of time, both through innovative policies and economic influence. The first plastic straw ban was implemented in Seattle in 2018, leading to several cities following suit and companies such as Starbucks implementing straw removal in stores nationwide (Gibbens, 2019a); California instituted the first statewide plastic bag ban leading several others to follow suit (Gibbens, 2019b); the Pacific Northwest was also one of the first regions to implement recyclable collection programs alongside New England (Waxman, 2016). While by no means is the west coast the *only* influential region when it comes to solid waste management policy, in many instances it has led the charge towards more sustainable initiatives. Seattle in particular contains an economic influence as well, housing the

headquarters of Fortune 500 companies like Amazon, Starbucks, and Nordstrom, leading to an opportunity for influence on a national scale (Fortune 500, 2020).

California similarly fulfills these parameters, particularly when considering economic influence, but a more extensive body of research exists around the state's solid waste infrastructure and policy, and as such Washington and Oregon appear to be a larger gap in existing knowledge. California also did not possess a city that adequately matched Seattle or Portland, providing limited ability to compare results, and as such was removed from this particular study with the recommendation that these methods could be applied to the state in the future to provide a broader range of evidence of this phenomenon.

The second influential factor for selection lies in the fact that both cities have a robust history of recycling policy that appears to have led to entrenchment. This is fairly common for most large cities in the United States but is a necessary prerequisite for selection. Formalized recyclable collection began in Portland in 1987, while a similar program in Seattle originated in the same year (Seattle Recycling Program, 2021; History of Portland, 2021). Each city therefore provides over 30 years of history to examine, providing a robust range of development for examination.

The third and final influencing factor is the potential for change in the regions of focus. Both Seattle and Portland have adapted solid waste management plans to include more sustainable waste management initiatives (Oregon adopting Sustainable Materials Management and Washington adopting Zero Waste), have active legislation this year that significantly engage with plastic product management, and appear to be moving towards attempting to break out of relying fully on the recycling-centric regime structure (Plastic Pollution and Recycling Modernization Act, 2021; Final Bill Report: E2SSB 5022, 2021). As such, this region of influence appears to be a key leverage point, and this research stands to support the efforts being made by these cities to develop to more innovative sustainable models.

1.3.2 Sector of Analysis

With region of focus established, it is then necessary to determine what sector acts as the strongest unit of analysis for this study. There are several relevant sectors within the waste industry that warrant investigation in this context, particularly when considering corporate, infrastructural, or policy angles. Each sector is significant, complex, and requires different forms of nuance when considered. In this instance, policy has been selected as the solitary sector of focus to ensure the appropriate time and detail can be invested.

The unit of analysis specifically, therefore, is the *policies and strategies* employed by regional officials as well as the perspective of the policymakers, city representatives, and individuals who may support those structures. Haulers, sorting facilities, commodities markets, and public stakeholders all fall outside of this immediate area of analysis in order to ensure the focus remains solely on the policy sector but are all considered as exogenous factors. To ensure these parameters were clearly identified a stakeholder map was created and can be seen in *Figure 1-4*.



Figure 1-4. - Stakeholder Map for the purpose of this study
 Source: Stakeholders-Graph, 2021; Republic Services GRI Report, 2019; Stakeholder Maps, 2018

Of course, within the policy structure national, state, county, or city policies all have the potential to be analyzed. In this instance, city policy was selected as the point of analysis with regional and state perspectives providing supplementary support due to the fact that policy changes in the waste management sector in the US often originate with cities first, then disseminate to state policy, and finally potentially national policy. National policy has shown to be fairly conservative in regard to waste management policy, with the Resource Conservation and Recovery Act (RCRA) standing as the federal solid waste regulatory system and providing regulations primarily centered on landfill management, open dumping, and safe hazardous waste handling (RCRA Overview, 2021). Any instruction in relation to recycling requirements are vague and phrased largely as encouragements, such as the primary requirement that “the State plan shall provide for a policy and strategy for encouragement of resource recovery and conservation activities” and that no local or state government are prohibited from creating recovery systems (Resource Conservation and Recovery Act, 1976, §256.30), leaving the specific enforcement, structure, rigor, and parameters of almost all other elements of recycling system design up to state and local authorities. The influence of state, regional, and city governance varies depending on the region of focus, for example in Oregon the state Department of Environmental Quality (DEQ) has a more significant realm of influence, but large cities have been found to have a strong innovative effect. For reference, a high-level overview of the power division between different policy levels is outlined in *Figure 1-5*.

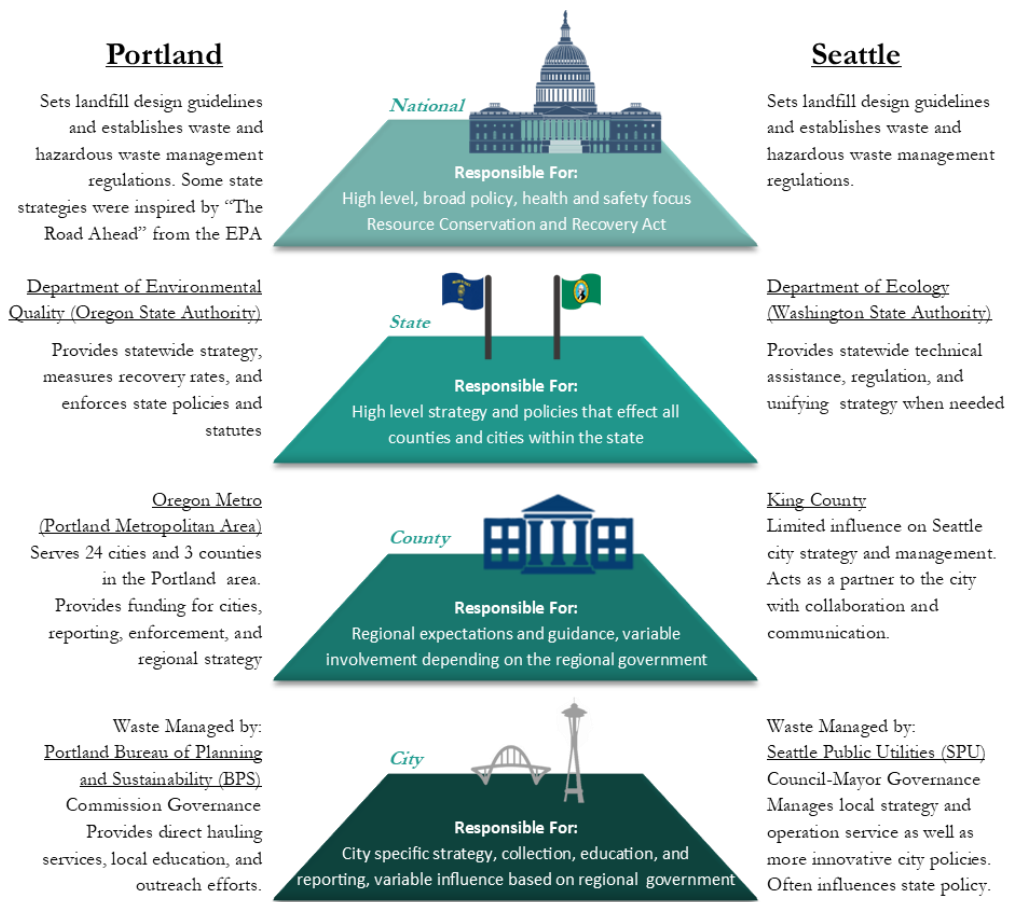


Figure 1-5. - High Level Overview of Division of Powers between Regulatory Authorities in the US
Sources: 2030 Regional Waste Plan, 2019; Seattle’s Solid Waste Management Plan, 2013; The State Solid and Hazardous Waste Plan, 2020; Wells, 2021; Sonders, 2021

Due to this structure of power, city (or in Oregon’s case the Metro and city) policy structures stand as the most influential opportunity for targeted innovative development with the target of that development expanding outward from there.

1.3.3 Material Stream

The processing stream of focus has been identified as recycling, with plastic as the material stream to be analyzed. Recycling was selected due in large part to its prevalence both in public interest and existing policy. In the US, over 40 states have set diversion targets for recycling, but there are far fewer regulations around extended producer responsibility, reuse, consumption reduction, or other strategies that have been identified to be more effective than their recycling counterparts (Murphy & Pincetl, 2013). Recycling is a key, ubiquitous policy initiative across the US when it comes to sustainable waste management strategy, and as such warrants deeper investigation.

Plastic has been selected as a sub-focus for this research due to its complexity and how challenging it has been proven to recycle. While some key plastic materials such as bottles and jugs recycle very well, many plastic recyclable materials are cited as the most challenging to recycle when compared to their counterparts of paper, cardboard, metal, and glass. As generation of plastic materials has increased, it has put a strain on recycling systems, and in many

ways acts as one of the primary breaking points for the efficacy of the recycling system. As such, it is a valuable case study to examine when considering the need for alternative solutions.

1.4 Ethical Considerations

In ensuring appropriate ethical guidelines were met in the execution of this research explicit care was taken to ensure that researcher integrity was maintained and accurate results were provided at every step of the analysis. No external funding was received during the process of this study and no external influence exerted pressure on the research during its execution. Care was taken to ensure personal perspectives, experiences, and biases had limited influence on the work through a careful establishment of a framework that could be systematically applied in the analysis of qualitative data.

In the case of interviews, all consent was received in three key categories to ensure voluntary, informed, and safe support of all participants. First, a consent form that can be found in *Appendix 2* was provided outlining the intent of the research, publishing plan, and how data would be used to ensure there was clear and informed consent. Second, verification on if anonymity was required as well as level of permission to quote participants directly was obtained. Finally, potentially attributable or provocative quotes and accounts used were verified both by the researcher and by peer examination to ensure they would not have the potential to damage reputation or cause any additional harm to participants. In the case that any quotes were potentially of concern, they either were omitted from the research or their use was authorized by the participant of concern to ensure reputation and dignity were preserved.

No personal information other than name and professional position were gathered in the context of this study. All personal information was stored in a separate document from the results gathered and saved in a password protected document to ensure data security. In the primary data document participants were listed by respondent number which was linked to the password protected document to ensure security. No other personal data was required to be collected in the case of this study. In the case of publication, quotes and data are listed in relation to professional position only.

1.5 Audience

The primary intent of this thesis is to provide information to support work in policy and strategic design and change in waste management circles. As such, the intended audience is waste management professionals who are responsible for designing and planning policy and strategy for sustainable waste management initiatives. This research is intended to create a baseline for discourse and a common language that can be utilized among these individuals when considering change initiatives. Similarly, it is meant to act as a more complex look at the nuance problems facing those policy and strategy makers to help establish a more nuanced baseline for what must be overcome to drive towards more innovative development. This text is most relevant for individuals in the United States, particularly in the selected region due to the regional focus but may be able to be more broadly considered in instances where regional similarities exist.

With this intention in mind, a policy brief document has been provided in *Appendix 1* to facilitate more accessible engagement with the topics enclosed and provide a more condensed summary of the research findings and conclusions.

1.6 Disposition

Chapter 1 of this study introduces the problem the study seeks to address; outlines the background of the challenge being examined; introduces the aim of the study; and provides study scope, ethical considerations, and the audience that will be addressed.

Chapter 2 provides an overview of the methods used in the development of this study, including how data was selected, how it was collected, and the process used to analyze it. This is provided both for case study data as well as interview-based data used in the course of this study.

Chapter 3 begins with an examination of plastic recycling limitations, followed by an examination of the theories that underpin the study and supplemental theories that support the research, concluding with a summary of gaps in existing knowledge and the framework that will be used to fill that gap and support the research is provided.

Chapter 4 presents the primary findings obtained through the analysis of collected data, summarizing key findings from four primary categories, followed by a comprehensive analysis of how that data may be interpreted.

Chapter 5 provides a discussion of what can be gleaned from the results obtained, and how these results can be utilized and applied in a practical context. It then provides an assessment of further research opportunities and generalizability potential.

Chapter 6 acts as a conclusion of the work and provides final take-aways for the audience and a total summary of the work. It also provides suggestions for how practitioners can utilize findings and research structure to fuel future action.

2 Research Design, Materials, and Methods

This research will be a qualitative, retroductive analysis, with the observed reality being the resistance to change when compelling data exists that change is necessary, and the underlying mechanism that may cause that reality is the element in question (Blaikie & Priest, 2019). The ontological assumption is related to depth realism, suggesting that social reality is constructed from social engagements and relations- these barriers to change are dependent entirely on social actors and a constructed social reality. The assumption of how knowledge about this question can be gained, or the epistemology of this study, will be based in neo-realism, which suggests that understanding of the observed problem can be obtained through observing and understanding the structures that causes it, suggested here to be a mix of sunk cost and lock-in (Blaikie & Priest, 2019).

2.1 Research Design

The research design was built around three distinct phases that were used to guide methodology construction and built to answer each research question. *Figure 2-1* provides a visual outline of the core conceptual research structure.

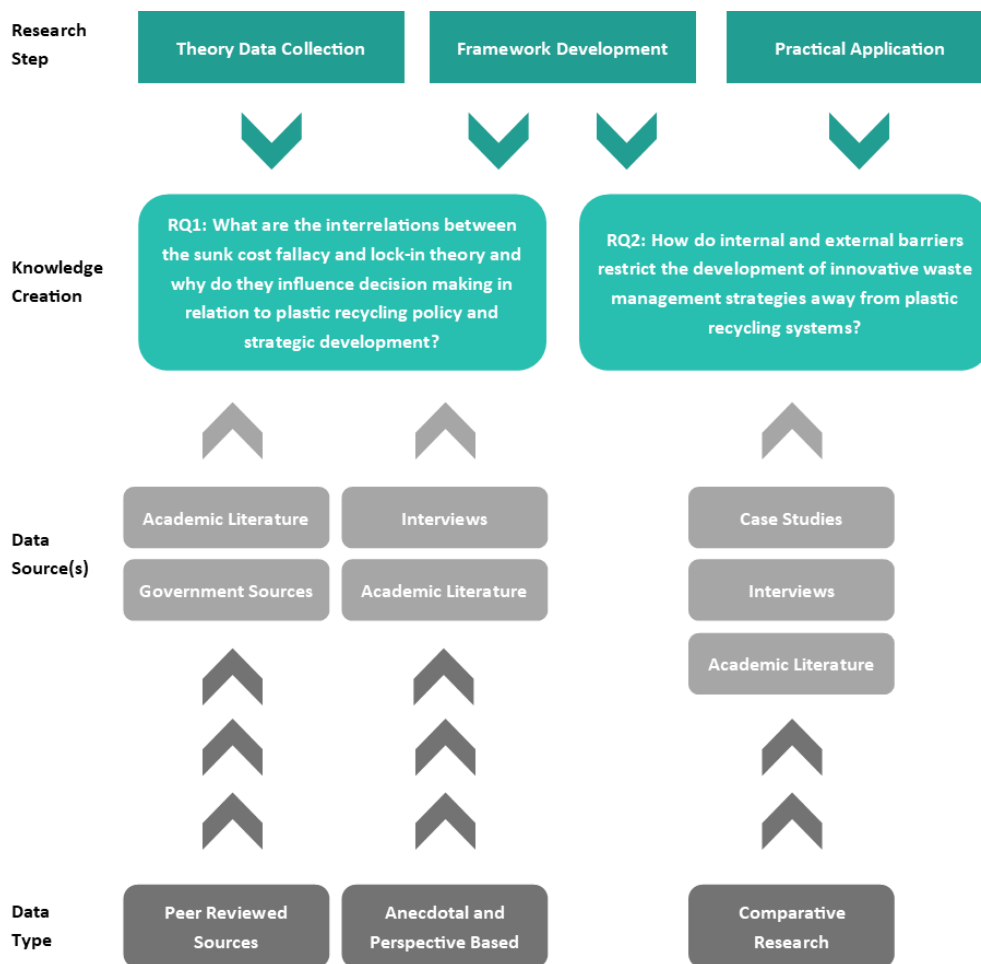


Figure 2-1. - Research Design Structure

From a step-by-step perspective, research began with the literature review of theories in order to create an initial theoretical framework that could be referenced and relied upon to codify data obtained in later steps. The second step involved identifying and selecting case studies in terms of the most relevant cities of focus. This determination finalized the decision of who to seek to

interview in this context. Strategy documents to be analyzed were identified based on visibility, state influence, and interviewee identification of relevant texts. This was then followed by data collection in the service of RQ2. With data collected, it was then coded, compared, and analyzed to create an updated framework and an understanding of findings, results, and conclusions.

A breakdown of design structure for each research question is outlined below:

RQ1: What are the interrelations between the sunk cost fallacy and lock-in theory and why do they influence decision making in relation to plastic recycling policy and strategic development?

Answering this question took place in two distinct steps: (1) examining and comparing research on sunk cost theory and lock-in to create a framework and set of key terms that outlined how these two theories relate to one another and then (2) utilizing that framework to determine how their joint influence effects policy and strategy making decisions in the waste sphere.

Theoretical synthesis for the first part of this question involved the examination of extensive academic literature which was then applied to a synthesis matrix to identify core recurring themes and concepts and create central definitions utilized in this research study (Sovacool, Axsen, & Sorrell, 2018). This research was conducted as a narrative review, which is defined by Sovacool et al. (2018) as “an exploratory evaluation of the literature or a subset of literature in a particular area” which can be used to synthesize existing knowledge and create a more detailed qualitative examination of existing concepts (p. 23). As such, there is some limitation in that researcher interpretation had influence on the interpretation of results, however the benefit to this research methodology is that a more nuanced, comprehensive definition that fits the nature of the research was reached.

Using this developed framework, it then became possible to address how this combined set of theories influenced waste policymakers. This was analyzed utilizing a mixture of interviews and supplemented with academic literature and regional strategy documents and reports. Interviews provide professional perspectives and represent narrative experience, however as interviews can be a variable, non-representative data set on their own due to their subjectivity, academic literature was used to supplement personal accounts and reports to lend greater validity to findings and conclusions in this subject.

RQ2: How do internal and external barriers restrict the development of innovative waste management strategies away from plastic recycling systems?

This element was assessed primarily utilizing case studies from two selected cities on the western coast of the United States that act as an in-practice representation of the identified barriers and the development of the current recycling-based structure. City policy was systematically reviewed through developing a comprehensive understanding of what policies currently exist in relation to recycling in each location. This systematic review was supplemented with interviews, news articles, and academic literature to provide an understanding of how these elements combine to influence future policy development.

Limitations are of course present in all proposed methodology, particularly in the qualitative nature of the steps of analysis- as such results will have limited generalizability and replication is dependent on the resources available in other regions of study (Blaikie & Priest, 2019). There also is researcher interpretation required in every step of the process, and other researchers may draw separate conclusions from the results. As such information is presented as extensively and clearly as possible to allow for full transparency of data and results.

To balance these challenges, the strengths of the research method can be found in their exploratory nature- maintaining an openness to whatever can be found provides a level of impartiality and honesty to the research that helped with the finding of well supported results that are representative of the experiences gleaned from the case studies and interviews examined. Through a comparative triangulation also, a flexibility and complexity of results was obtained to provide nuance to the broader academic discussion.

2.2 Methods Used to Collect Data

Data was collected from three primary sources to ensure internal validity and complexity of results: (1) Academic Literature; (2) Case Studies; and (3) Practitioner Interviews:

2.2.1 Academic Literature

As the first step to support the remainder of research, the literature review was conducted in accordance with three key, systematic stages to ensure internal validity. These steps, as outlined by Jesson & Lacey (2006), were: (1) Methodic Searching; (2) Analysis; and (3) Presentation.

In the search stage sources for each theory were selected from several interdisciplinary perspectives, including psychology, neurological science, behavioral economics, organizational theory, political science, and sociology to construct a representative perspective with limited bias (Jesson & Lacey, 2006). A range of targeted search terms were used to ensure a broad range of perspectives were obtained. Search terms evolved and increased to match other terminology of interest as it arose within research texts.

In the analysis stage, as sources were identified and obtained, they were skimmed and evaluated for applicability in relation to the topic and graded on a three-level scale of relevance. Relevant texts were highlighted for further examination while less relevant texts were saved as potential future reference options. Relevance was determined based on a set of criteria, including reference to the topics of focus, region of focus to ensure case study applicability, and date of publication, all of which were considered to ensure current, regionally and conceptually applicable works were utilized. Further documents were identified based on references found within the articles obtained in the search stage, as well as through conversations with subject matter experts who helped provide pertinent texts to the theoretical discourse. Once a sufficient number of sources were obtained to support construct validity through the use of multiple texts, relevant references were then read more intensively and useful data was highlighted for synthesis and analysis (Yin, 2014).

In this intensive reading, relevant data was compiled into a synthesis matrix containing key terms and concepts that required development such as theory definition, identification criteria, theory subcategories, and limitations. This was done with the intention of identifying patterns of analysis and information between sources, to ensure internal validity (Yin, 2014). As patterns arose, these reoccurring data pieces were evaluated and compiled to create a standardized, consistent framework.

2.2.2 Case Studies

In order to ensure this case study was of appropriate quality, four parameters were met: (1) construct validity; (2) internal validity; (3) external validity; and (4) reliability (Yin, 2014). All of these parameters were tested and verified throughout study design, but the selection of case studies largely served to support the effort to ensure external validity, through utilizing multiple case-studies as a way to verify replication of results through reoccurring patterns between both cases (Yin, 2014). Seattle and Portland were originally selected for the reasons listed in section

1.3.1, but secondary verification had to occur to ensure appropriate relevance and similarity so external validity could be achieved.

Cities were selected from two states rather than one to provide a more ranged representation, however cities that had close geographical proximity were chosen to increase the accuracy of results. Cities were selected for three key factors: population, similar timing of formalized curbside collection service establishment, and level of influence. The details of this examination can be found in *Table 2-1*. The next largest cities in each state were included in the evaluation for comparative context.

Table 2-1. Case Study Selection Parameters

City	State	Population	Began Recycling	Plastics Recycling System
Seattle	Washington	724,305	1987	Single Stream Recycling
Spokane	Washington	217,353	1990	Single Stream Recycling
Portland	Oregon	658,645	1987	Single Stream Recycling
Salem	Oregon	176,084	1992	Single Stream Recycling

Source: Spokane County Solid Waste and Moderate Risk Waste Management Plan, 2015; Berenyi, 2010; Curbside Collection, 2021; Solid Waste Services, 2021; Recycling- What Goes in the Bin, 2021; Recycling, 2021

Population was used as the first reference point and was considered with two separate lenses. Cities selected needed to have fairly similar population sizes to ensure the cities could be adequately compared. California was initially considered to be included in this work but due to the lack of comparable city structures it was excluded to ensure higher accuracy of findings. As Seattle and Portland vary in population by approximately 65,000 people, they were deemed appropriately similar ‘mid-sized’ cities for evaluation. Population was also considered in relation to influence- as the largest cities in each state by about 500,000 residents each, Seattle and Portland have the largest direct influence on regional populations as well as the strongest pull in their respective state legislation and policy development.

Similar timing of formalized recycling program was prioritized in order to ensure that enough time for fairly similar entrenchment parameters could occur. If both programs have been active for an approximately similar amount time, lack of time for a program to become established is not a concern that may skew the data.

Plastic recycling stream is the final piece that necessitates consideration. Though it lacks variation in the table it was necessary to ensure that the collection process for plastics was the same between the cities being studied. Single stream recycling indicates that multiple streams of material are collected in one bin in the curbside collection process: in Seattle this means cardboard, paper, plastic, metal, and glass recyclable items are collected together (Recycling, 2021) and in Portland this means paper, cardboard, plastic, and metal are all collected together as glass is separated by the waste generator (Recycling- What Goes in the Bin, 2021). Collected items are then brought to a material recovery facility (MRF) to be separated into their independent material stream and sold for use in future production. In instances where all plastic is separated out at the source, it is managed differently and therefore the issues related with its recyclability are similarly different. As these cities have similar collection and sorting systems this variability does not need to be considered.

2.2.3 Interviews

Respondents for interviews were gathered utilizing the snowball or network method, beginning with the contact of five identified professionals who then provided contacts who they believed would provide valuable insights to support the research work (Blaikie & Priest, 2019). Limitations to this is that it does not act as a fully representative sample of all perspectives, but as the pool of waste policy and strategy makers in each selected city is fairly centralized the concern of this bias is less significant. In order to ensure consistent representation of primary policy and strategy making expertise in each area at least one individual connected to the city’s central waste management authority was contacted.

Interviews were conducted with a semi-structured approach with a fixed topic and fixed questions but with a built-in flexibility to allow conversation to naturally transition into personal experience and allow for a more unbiased collection of data. The interview guide utilized is outlined in *Appendix 3* for reference.

Primary data intended to be obtained and the research questions they will address are outlined in *Figure 2-2*.



Figure 2-2. - Data to be Gathered in Interviews

2.3 Materials Collected and Analysis

2.3.1 Literature Review

In total, data was collected and analyzed from 70 academic sources, 20 of which analyzed the sunk cost fallacy, 13 of which analyzed lock-in, 10 of which analyzed the limitations of plastic recycling, and the remaining 27 examining supporting and opposing theories such as loss aversion, escalation of commitment, and bounded rationality. From the 33 sources used to examine sunk cost and lock-in, two sources were identified as key to the framework developed based on frequency cited and applicability to the study. For sunk cost, “The Psychology of Sunk Cost” by Arkes and Blumer (1985) was selected as the base theory with the remaining 19 articles utilized as supplementary research and support due to the common reference of this material in the majority of literary documents analyzing sunk cost. Similarly, “Infrastructures, Lock-In, and Sustainable Urban Development: The Case of Waste Incineration in the Göteborg Metropolitan Area” by Corvellec et al. (2012) was selected as the primary reference point for lock-in due to its clear development of a framework to assess lock-in and its relevance to other texts written on the same subject.

To analyze collected data in this context, all relevant data and findings were collected in a synthesis matrix and then analyzed to identify reoccurring themes and similarities, and develop a cohesive referential definition and framework for the identified theories of sunk cost and lock-in. These findings are provided in Section 2.4.2- Framework, within the literature review.

2.3.2 Case Studies

Several points of data were collected to assess the two case studies of concern. Documents were selected based on a set of criteria including visibility; influence on state, county, or city strategy; and frequency document was mentioned in interviews. Documents were analyzed under three separate categories outlined in *Table 2-2* below.

Table 2-2. Case Study Data Overview

Category of Data	Region	Document Name	Information Provided
Strategy	State - Oregon	2050 Vision and Framework	The public facing priorities and vision for the represented regional government as well as corroboration of interview data for identified barriers
	State - Washington	The State Solid and Hazardous Waste Plan 2021 - 2026	
	County - Metro	2030 Regional Waste Plan	
	City - Seattle	Seattle’s Solid Waste Management Plan 2013	
Metrics	State - Oregon	2018 Oregon Material Recovery and Waste Generation Rates Report	Metrics used, progress prioritized, and how success is identified with internal and external stakeholders
	State - Washington	Waste Generation and Recovery Data (2017)	
	City - Portland	Portland Recycles! Project Report and Action Plan	
	City - Seattle	2019 Annual Waste Prevention and Recycling Report	
Upcoming Legislation	State - Oregon	Senate Bill (SB) 582-1	Current priorities and regional focus, both bills referenced in interviews as large pushes/steps forward for state policy
	State - Washington	Senate Bill (SB) 5022	

In order to maintain as similar a research design as possible between the two cities of analysis, reports that provided a similar purpose to one another were found in every instance they were available. In the instance that similar documents were not available, data was found that fit the same purpose in a different report type. Of note in the ‘strategy’ category is that county was selected for Oregon while city was selected for Washington. This is due to the nature of primary strategy influence in the region- in Seattle, the city utility, Seattle Public Utilities manages the primary strategy for the area. In Portland, Metro is largely in charge of strategic initiatives, while the City of Portland’s Bureau of Planning and Sustainability does not appear to have a similar strategy document available for public use.

2.3.3 Interviews

11 interviews were conducted with 12 individuals who work in or engage with policy and strategy development in the solid waste domain, 6 from the Seattle region or Washington regional perspective, 5 from the Portland region or Oregon, and 1 with expertise in both regions of interest. Interview length ranged from 30 minutes to 1 hour, and all interviews were recorded and transcribed for the analysis process.

Table 2-3. Interview Summary

Category	Company Type	Contact
State	State Government Department	Coordinator
	State Government Department	Analyst
	State Government Department	Coordinator
Regional	County/Regional Body Department	Director
	County/Regional Body Department	Manager
	County/Regional Body Department	Manager
City	City Department/Utility	Coordinator
	City Department/Utility	Strategist
	City Department/Utility	Director
Hauler or Recycler	Solid Waste Hauler	Manager
	Solid Waste Hauler	Manager
Consultant	Environmental Consultancy	President

Relevant statements and data were highlighted and codes were applied as a way to trace consistent themes and manifestations of the identified theories in the research framework. These findings were then collated to identify both how frequently certain theoretical concepts were mentioned (for example, how frequently instances of technical lock-in manifested) as well as identify key perspectives and qualitative understandings that could be gleaned from these perspectives.

3 Literature Review

3.1 The Limitations of Plastic Recycling

The intention of this research is not to indicate recycling does not have value or should be eliminated entirely. Instead, the intention is to highlight the knowledge that recycling is insufficient as the primary solution for plastic waste management, and to understand why solutions that prioritize recycling-first systems continue to be engaged with despite this knowledge. As such, first it is necessary to establish a foundation of what limitations exist in the plastic recycling system and why moving away from investing in it as the primary solution is so vital. This can best be understood through three primary limitations: (1) limitations in substitution; (2) limitations in efficacy; and (3) limitations in public trust.

3.1.1 Limitations in Substitution

Like many countries, the United States recognizes the ‘waste hierarchy’ as the best way to understand “the various [waste] management strategies from most to least environmentally preferred” (Sustainable Materials Management, 2021). This hierarchy highlights recycling behaviors as second to source reduction and reuse as far as environmentally preferable behaviors, and as such reduction and reuse behaviors should be prioritized over recycling ones when aiming for sustainable best practices.



Figure 3-1. Waste Management Hierarchy Followed by the US EPA
Source: *Plastics: Sustainable Materials Management, 2021*

Of course even higher on this hierarchy, exists the coveted ‘reduction,’ and as such there are three ‘R’s’ that in theory should be prioritized over recycling action. Yet despite this, while recycling rates have increased in many areas, waste reduction, reuse, and repair have not mirrored these positive results (Amato, Mancinelli, & Zoli, 2016). This contradiction can be partially explained through existing policies and infrastructure which will be examined further in this study, and of course existing packaging and producing structures are partially to blame, yet there is another causal element that warrants consideration: recycling can often act as a substitute for more desirable sustainable behaviors (Ma, Li, Jiang, & Jiang, 2018).

Recycling holds a strong position among sustainable initiatives in broader society, enjoying “widespread, often passionate support” among the broader public (Ackerman, 1997, p.4). It is often spoken of as ‘the right thing to do,’ and this moral positioning establishes recycling as an

act of altruism (Ackerman, 1997). Studies suggest that individuals may use it to bolster an “environmental self-identity and feelings of pride” (Ma et al., 2018, p.871). Alongside these moral establishments, it is also fairly accessible and easy to do, creating a perfect behavior that can be used to substitute for other, more difficult sustainable actions. When recycling is perceived as a pro-social, good behavior, “individuals’ recycling efforts can increase their subsequent resource usage” (Ma et al., 2018, p.875).

This effect of substitution has been explained in a variety of ways, some use ‘moral licensing,’ others ‘compensatory beliefs,’ while others still reference it as ‘substitution,’ but the resulting effect is similar: the act of recycling is performed as a positive environmental behavior and this positive behavior is used to justify other, less positive environmental acts (Ma et al., 2018; Hope, Jones, Webb, Watson, & Kaklamanou, 2018). MacBride (2012) describes it as ‘busy-ness’, a “form of derailment” (p.4) that “brings positive side effects but fails to reach the central effect” which in this case is resource conservation related to consumption (p.6). Ma et al. (2018) calls it moral licensing, which postulates that individuals who engage in ‘good’ behaviors will then use those behaviors as license to engage with ‘bad’ behaviors due to a positive boost to sense of self. Others still call them compensatory beliefs, which are ways for individuals to rationalize behaviors which do not align with their beliefs or goals (Hope et al., 2018). In all cases, the idea behind it is a kind of substitution, choosing recycling over the other, more desirable reduction, reuse, and repair behaviors.

Several studies provide compelling evidence of this claim, that individuals may increase or maintain consumption levels in response to positive recycling behavior. These findings indicate that individuals who put high energy into recycling may “feel they have made progress towards environmental goals and then relax their behaviors” to engage in over-consumption (Ma et al., 2018, p.871). In many instances this is done through individual reasoning that “they can indulge now and compensate later or indulge now because they previously acted in virtuous ways” which helps reduce guilt surrounding negative behaviors (Hope et al., 2018). Hope et al. (2018) found that in the case of recycling, individuals were prone to utilizing compensatory beliefs as a way to justify less sustainable behavior, further supporting the moral licensing effect.

These conclusions however are not universally agreed upon, indeed Amato et al. (2016) found that recycling and reduction may actually strengthen one another depending on the circumstances. As such this finding may be dependent on cultural factors, individual identity alignment with sustainability, and other elements that may influence behavioral patterns. As such these effects should be considered but not treated as universal fact in investigation.

Similarly, this should not be understood as a universal condemnation of recycling. Recycling is a strong instrument, a necessary tool in the broader toolbelt of waste management. However, it is a band-aid, a way to treat a broader ill. It is when recycling is treated as a cure, as is seen with moral licensing, that the limitations arise.

3.1.2 Limitations in Efficacy

These moral licensing effects would already be a challenge if behaviors were being diverted from a more effective behavior (like reduction) to a less effective one (like recycling), however they are compounded by the fact that in the case of plastic, recycling is rapidly losing efficacy due to the complexity of the materials at hand. To understand why sorting is so challenging in regard to plastics, *Figure 3-2* provides a brief overview of how sorting functions in a standard single stream collection system.

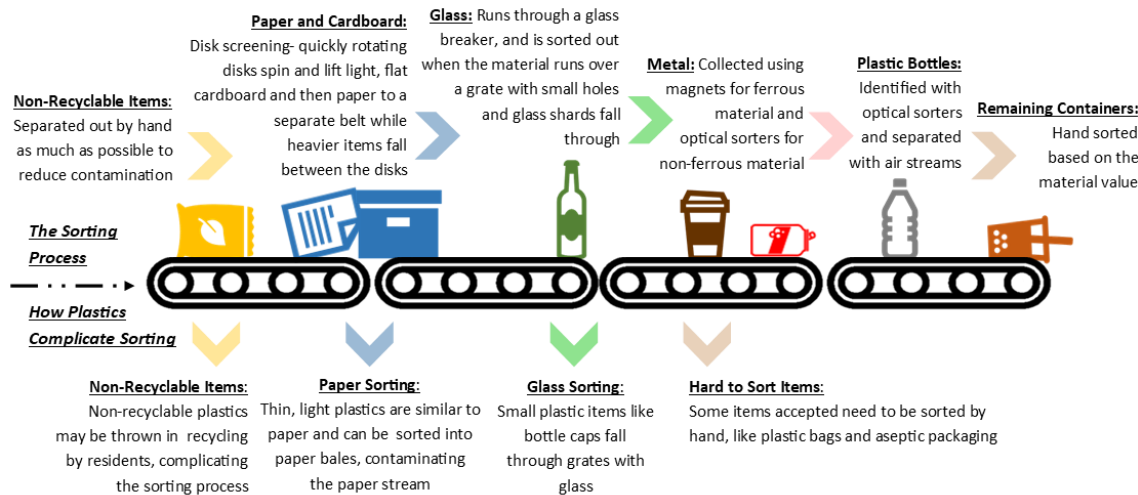


Figure 3-2. An Overview of the Standard Sorting Process at a Material Recovery Facility in the US
 Source: Waste Management Single-Stream Recycling, 2015

There are many similarities between the Seattle and Portland commingled collection systems with some variation in what plastics are accepted as recyclable as well as the fact that in the Portland system glass is source separated, meaning that it is put in a separate bin for collection by residents and commercial customers. While glass can cause some complications in the sorting process, affecting end cleanliness of products like paper due to microscopic shards puncturing other materials, it has limited impact on the plastics issue at hand. Bottles additionally can be source separated in Oregon due to the state’s bottle bill, but as residents may still place bottles in single stream recycling, this provides a negligible difference in the process (Oregon’s Evolving Bottle Bill, 2021).

When it comes to plastics, there can be high environmental benefit for their recycling, but these benefits can only be obtained when there is “high quality output and high reuse potential in mind” (Milius, Davani, & Yu, 2018, p.2). Yet in material recovery facilities serving large populations which may sort through up to 15,000 tons of recyclable material per month, that high quality output is difficult to obtain (Republic Services Material Recovery Facility, 2017). This is largely because there are so many different types, sizes, and shapes of plastics that sorting them out to the level that would be needed for them to be effectively recycled is extremely challenging. Plastic recoverability also relies on *quality*, which can often be impacted by cleanliness, particularly in the case of softer plastics which may be damaged in a single stream collection process (MacBride, 2012). Finally, there must be appropriate market justification for the cost of labor and equipment required to isolate specific types of plastics, and “strong, reliable markets upon which to sell sorted plastics” (MacBride, 2012, p.178). These markets can only exist if there are good quality and high quantities of material, which is why in reality only PET and HDPE bottles and jugs are “recovered consistently and viably in the municipal curbside collection systems of every U.S. city” (MacBride, 2012, p.178).

All of these factors are on display when examining documentation of collected inputs and actually recyclable outputs from the plastic recycling process. An example of this limitation can be seen in a proposal prepared for Plastic Recyclers Europe, which when outlining the feasible targets for plastic packaging recycling in 2020 highlighted that even with an assumed 70% collection rate of plastic material, only 45% of that material could feasibly be expected to be recycled (Hestin, Faninger, & Milius, 2015). In 2025, those numbers increase slightly, to an 85% collection rate and a 60% output of recycled material, but these projections outline a stark 30-40% predicted loss of material in the recycling process (Hestin et al., 2015).

While in theory, many plastics can be effectively recycled, this is much more likely to be the case in systems where all plastics are source separated (MacBride, 2012), which is not the case in most cities in the US. Single stream systems provide alternative benefits- they are more highly accessible for sorters, decreasing the burdens on the waste generator by managing the sorting on the back end. It becomes a question of quality (source separation) or quantity (single stream), and in the world of plastics the necessary quality for many niche items is not sufficiently met, leading to a pile of low quality “tubs, trays, and housewares” that are collected but have limited opportunities for use (MacBride, 2012, p.180). While recycling is certainly still a valuable tool, these numbers highlight that it cannot be utilized as the primary sustainable cure to the rapidly growing waste issue, particularly in relation to plastics, and cannot act as a substitute for other sustainable behaviors.

3.1.3 Limitations in Public Trust

With societal structures that rely upon recycling as a ‘moral good’ that can act as “a form of penance” for high-consumption lifestyles (Ackerman, 1997, p.10) coupled with a recycling system that is failing to *provide* that moral absolution in the context of plastic, a precarity arises. That is, as the public realizes that the recycling system is failing to meet the ethical value that has been ascribed to it, a failing of trust arises. This is best illustrated by news articles over time and how they have engaged with recycling practices supplemented with academic analysis.

Public critique of recycling as a system is not new: John Tierney’s article, “Recycling is Garbage” (1996) was seminal, giving rise to hundreds of citing articles engaging with and addressing his concerns. Tierney (1996) argues that in the US, the passion for recycling was incited with the belief that landfills would become overfull and there was a public responsibility to reduce the amount of landfill space used for this reason. This, Tierney argues, is what instilled a cultural tie to recycling in the US, but that thread of belief and demand for recycling has been carried with its population even as times and understandings change. While his argument responds to past conditions, his words are still often quoted in waste circles today, stating that Americans are, as a whole, reliant on recycling as an “act of moral redemption” and in this reliance, “we’re performing a rite of atonement for the sin of excess” (Tierney, 1996).

Tierney’s condemnation and worries are reflected in the present, particularly as concerns about whether plastic is truly being recycled have risen in the last three years in response to China National Sword, a trade policy implemented by China in 2018, significantly limiting the materials and contamination levels of recyclable bales that they would accept as imports. Coverage on this issue ranges across several more recent news articles, such as a National Geographic issue, titled “Planet or Plastic” published in June 2018, which painted a stark picture of the production, consumption, and end-of-life damages resulting from plastic (Parker, 2018). Part of the article was dedicated to the international damages caused by the US shipping plastic recycling overseas, emphasizing the failure of recycling present in the system at the time.

This article was followed in June 2019 by The Guardian, who published a piece titled “Where Does your Plastic Go?”, examining what was done with plastic material sent to 11 different countries for recycling (McCormick, 2019). The article presented the problem that after China Sword, plastic material became “a global hot potato, ping-ponging from county to country” to places poorly suited to manage it (McCormick, 2019). The article outlined a similar problem to the one presented by National Geographic- a good deal of plastic recycling was not being recycled, instead “discarded because it [was] unusable”, becoming waste once it was shipped overseas (McCormick, 2019).

Laura Sullivan published the next article that caught widespread public attention, “How Big Oil Misled the Public into Believing Plastic Would Be Recycled” (2020). Sullivan examined the limits

of the recycling market and how the public believed in recycling to the point of reliance, with the specific lens of plastic recycling. “Selling recycling sold plastic, even if it wasn’t true” Sullivan (2020) writes in a commentary that drew the public’s interest and called concern to the viability of recycling, 30 years after Tierney’s work did the same. “If the public thinks that recycling is working,” Sullivan states, “then they are not going to be as concerned about the environment” (2020).

Most recently, in March 2021 Last Week Tonight with John Oliver, a popular late-night television show that specializes in detailed coverage of societal issues, aired a 22-minute segment on the issue that captured broad public notice (Plastics, 2021). In it, Oliver presented a story now familiar: “for all the hype about recycling” Oliver states “a lot less plastic winds up getting recycled than you might think” (Plastics, 2021). Oliver provides the most comprehensive examination of the problem yet: covering how purchasing behavior is made around the belief most plastics can be recycled and recycled well; how many plastics instead end up in international countries that either landfill or incinerate the material which leads to significant negative human health impacts; discussing how many plastics are downcycled leading to less effective recycling practices than society initially assumed; and emphasizing the systemic challenges incumbent in the plastics industry (Plastics, 2021). Oliver also takes a moment to highlight a key truth in this challenge: “it can seem that recycling is pointless” he states, “but it’s important to know that it’s not...even recycling plastic...can still have modest environmental benefits” (Plastics, 2021). What is necessary is more conscious engagement with the process and a demand of the systems and structures surrounding the recycling process to change.

This history of publications reflects the concerns of efficacy and moral licensing outlined previously- society relies upon recycling both as a service and as a moral absolution, but it is rapidly becoming clear, particularly with increasing export bans rising from National Sword and shifting plastics markets, that in the case of plastics recycling cannot suitably meet that need. Plastic recycling serving as a substitute in some cases for more desirable practices, challenges in sorting plastics, limited markets, and downcycling when materials *do* make it to re-production; these factors provide a strong outline for why recycling cannot act as the primary solution for plastics, an understanding that appears to be beginning to be reflected in public opinion.

3.2 Theories of Potential Barriers to Change

Despite the conditions and the data showing change is needed, however, that change has still proven difficult to make. While several disciplines have examined the limitations to change in policy, and several different theories exist, in this case two theories appear to be highly applicable in explaining this phenomenon: (1) The Sunk Cost Fallacy as a way to examine the *internal* barriers that may be restricting policy makers from investing in change and (2) Lock-In Theory as a way to examine the *external* barriers.

3.2.1 Sunk Cost Fallacy

Behavioral Economics

In neoclassical economics, the primary traditional economic theory, it is stated that “human decision making and behavior are based purely on rational choice”, positioning individuals as creatures who always act to maximize utility, with full information and fixed preferences (Frederiks, Stenner, & Hobman, 2014, p.1386). This creates a model that does not need to consider the changing whims of human behavior, leading to what has been described as an “anti-behavioral” system of evaluation (Mullainathan & Thaler, 2000). Behavioral economics originated as a direct response to this theory, suggesting instead that “people are rarely rational decision makers” and are instead limited by fundamental biases that bound human behavior and decision making (Frederiks et al., 2014, p.1386). These three bounds were originated by Simon

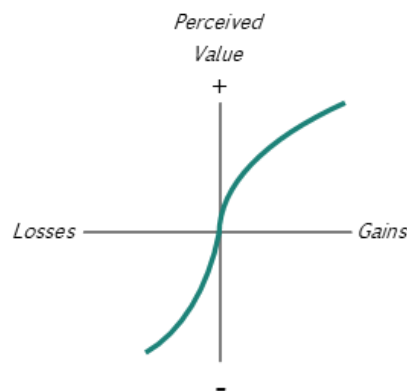
(1972) who outlined them as (1) bounded rationality: the limitations of human decision making; (2) bounded willpower: the fact people may make decisions that will not maximize utility in the long run; and (3) bounded self-interest: the fact that individuals will accept a loss of personal benefit to assist others. All of these bounds limit human capability of making rational, utility optimizing decisions, leading to decision makers being forced to do their best to make choices in a complicated world (Forester, 1984).

Human rationality may be bounded due to a few different limitations: *judgement or belief* may force the individual to make decisions based on the information they have on hand, using either intuition or habit to help guide complex decision making; *risk and uncertainty* may cause decision makers to hesitate to make certain decisions due to an aversion to loss; or *framing* may influence decision makers, causing them to receive information in a way that guides them to a specific choice (Kahneman, 2003). In many cases bounded rationality is caused due to the need to make certain choices in an uncertain world- human brains can only process so much information so quickly, and making complex decisions takes energy. To manage this, different heuristics are utilized, many of which can be explained in part by prospect theory.

Prospect Theory and Sunk Cost

Prospect theory is a way to explain how individuals make decisions in uncertain conditions, originally introduced by Kahneman and Tversky (1979) as a direct response to the primary theory of the time, utility theory. Utility theory suggests that ‘the utility of outcomes are weighted by their probabilities’ in decision making processes (Kahneman & Tversky, 1979, p.263). As a direct counterpoint, Kahneman and Tversky (1979) suggested that humans in truth make decisions utilizing a complex form of mental accounting that evaluates gains and losses based on changes from the status quo as a reference point, with losses being weighted more heavily than gains. Sensitivity to these losses and gains *does* decrease the higher the gain or the greater the loss, but this depreciation occurs more quickly in relation to gains, leading to an even greater disparity when it comes to resistance to loss (Thaler, 1999).

This theory has been represented in the ‘value function,’ which is a visual presentation of the theory at work and can be seen in *Figure 3-3*.



*Figure 3-3. Prospect Theory's Value Function
Adapted From: Kahneman and Tversky, 1979*

Prospect theory can be related to several bounded rationality behaviors identified by behavioral economics, in loss aversion, risk aversion, status quo bias, and most importantly in this case, sunk cost bias.

The sunk cost fallacy, which is also referred to as ‘sunk cost bias’ when effecting human behavior and perception, originated with Arkes and Blumer (1985) who defined it as “a greater tendency to continue an endeavor once an investment in money, effort, or time has been made” (p.124). Over the development of this theory, though it has been expanded on by many academics and across disciplines, this definition has remained fairly constant, with a few key additions. Yoder, Mancha, and Agrawal (2014) highlight that these costs cannot be recovered, a key element reflected in several other texts that explains the resistance to give up on an investment. It speaks to a common adage “waste not want not,” a “proscription against wastefulness [that] makes further investment seem reasonable” as the costs that have already been invested cannot be reclaimed (Arkes, 1996, p.214). This concept of sunk cost manifesting from a desire to avoid wasting previously invested resources is a primary theory for the reasoning behind the phenomenon. This mindset is a bounding of rationality as theorized by behavioral economists—the fact that decisions are made based on *past* investments, which in the realm of rationality should have no bearing on *present* decisions (Strough, Sclosnagle, Karns, Lemaster, & Pichayayothin, 2014). In later expansion of the theory, sunk cost also was tied closely to prospect theory, as the *current* investment is accounted as the ‘status-quo’ for individuals, and any change from that investment condition is considered both a risk and a potential for loss, which is theorized to contribute heavily to sunk cost bias decisions (Arkes, 1996).

Sunk cost has expanded greatly from its origins as a solely economic theory, expanding to psychology and neurobiology which has sought to understand how the phenomenon manifests in the brain and influences general human behavior (Haller & Schwabe, 2014); to political science assessments of how it influences project decisions (Miller, 2019); to organizational theory where some utilize its psychological basis to examine how individuals may influence organizational decision making in relation to direction and investments (Beugré, 2018) and beyond. Across disciplines, the definition remains fairly constant: the key concept of commitment to an endeavor; the primary categories of assessment being money, time, or effort; and the influence of past investments on future decisions all key components to the majority of analysis across disciplines.

In a policy assessment made by Miller (2019), it is largely the focus that changes— the investment of inquiry becomes focused on *projects* and strategies rather than purely financial investments, highlighting the commitment to policies, interventions, or ventures and the political difficulty that comes with changing course (Miller, 2019). This political science perspective still considers financial investments related to project and policy development but may also weigh temporal and effort based sunk costs more heavily depending on the element of investment being investigated. This is because of the mental accounting that accompanies investment decisions.

Mental accounting, defined as the way individuals code, classify, and assess events or investments using the status quo as a baseline, is theorized to be the primary way these sunk costs are tracked and evaluated (Thaler, 1999). It has been found that the larger the past investment as accounted by the individual deciding if they should continue that investment, the more likely sunk cost bias is to come into play (Tait, Harold, & Miller, 2019). This mental accounting varies based on framing in a couple of key ways. First, the *category* of cost (money, time, or effort) may be weighted more heavily depending on ‘decision domain’ (Strough et al., 2014). In other words, in investments where time is considered more of a valuable resource, like in social relationships, temporal sunk costs may be weighted more heavily as opposed to in instances where money is considered more valuable such as in financial investments (Strough et al., 2014). Second, costs like time and effort may be more nebulous and difficult to apply direct numbers to, how each category of cost is evaluated may differ psychologically, making calculations of temporal sunk costs and even more so effort sunk costs harder to calculate

scientifically and more variable (Pandey & Sharma, 2019). *Figure 3-4* provides an overview of how these different categories may be considered by the decision maker.



Figure 3-4. Key Sunk Costs and their Properties
 Source: Tait et al., 2019; Pandey & Sharma, 2019

It is of note that one other sunk cost was proposed in a policy context, and that was lives lost per Miller (2019). In several policy contexts that is certainly a relevant factor, but in relation to waste policy it is less pertinent and as such will not be included in this analysis.

Of course, a natural next question is what causes this phenomenon to occur. While there is no singular agreed upon explanation, there are a few key hypotheses that are commonly utilized in the available literature to explain what leads to the sunk cost bias in decision making. The most common explanations fall into four main categories: (1) Not wanting to waste previously spent resources; (2) Values attached to the investment; (3) Loss aversion; and (4) Concerns about public image and credibility. Risk aversion is also mentioned in some instances with a suggestion that individuals typically prefer the known to the unknown, but as this explanation is featured less heavily in the research it is not considered one of the primary theories (Beugré, 2018).

Waste Aversion is often one of the primary reasons cited for sunk cost behavior- explained simply as the fact that “we often feel we have invested too much to quit” (Arkes & Blumer, 1985, p.126). Despite the fact that, according to rational theory, once those resources have been expended they should have no bearing on future decision making, the perception is that once one stops working towards an investment, or accepts a project as a failure, their previous efforts to realize that investment will be wasted molds decision making (Walton, 2002). As waste is identified as a negative in many cultures, and many have a “desire not to be wasteful”, the choice is made to persist with the investment in the hopes that it will bear fruit (Baumeister & Vohs, 2007). Waste not want not is a commonly utilized phrase in sunk cost bias examinations, alongside the adage ‘throwing good money after bad,’ the action that typically follows in response to this resistance to waste (Tykocinski & Ortmann, 2011). After all, giving up on an investment or a project that has not reached its intended goal is understood as a definite loss, but continuing to invest with the potential for recovery holds the possibility for gain and the possibility that those resources may not be wasted after all.

Personal Values can guide the way decision making is shaped in relation to sunk cost as well, in a way that heavily crosses paths with the psychological theory of cognitive dissonance. Cognitive dissonance is a well-established theory defined as “the aversive state of arousal that occurs when a person holds two or more cognitions that are inconsistent with each other” (Baumeister & Vohs, 2007). With this inconsistency comes discomfort, or ‘dissonance,’ which individuals strive to reduce through rationalization behaviors (Festinger, 1957). Through this rationalization, one of the cognitions, which can be understood as knowledge or beliefs, is changed by the individual either through reducing the importance or the belief behind the cognition, with cognitions that have “low resistance to change” shifted first (Brehm & Cohen, 1962, p.4). Cognitions that involve *commitment*, particularly public commitments, have a high resistance to change and therefore other cognitions that conflict with those commitments are more likely to be changed in response to dissonance (Brehm & Cohen, 1962). The relation therefore to sunk cost, is that people are often “unwilling to accept that their initial investment was a mistake” particularly in instances that relate to public commitments like policy and strategy interventions (Emich & Pyone, 2018, p.579). Beliefs that the investment might not be successful, or doubts relational to maintaining investment trajectory, may be shifted to lessen dissonance, leading to an “increased willingness to expend further resources on the task” (Arkes & Blumer, 1985, p.137).

Loss Aversion has already been mentioned in relation to prospect theory, and accordingly both are theorized to have some bearing on sunk cost biases. Loss aversion is a behavioral economics concept directly relational to prospect theory, quite simply is defined as “people’s tendency to prefer avoiding losses to acquiring gains of equal magnitude” (Baumeister & Vohs, 2007). Loss aversion is most commonly used in a financial context, but similarly to sunk cost bias it can be applied in several contexts, in resistance to upgrading technologies, in resistance to losing physical assets, and indeed, in resistance to the loss of already invested resources be they monetary or otherwise (Novemsky, & Kahneman, 2005). Once again, these losses are evaluated based on the current status quo, which in the case of sunk cost is the active investment position, and as such any move *away* from that status quo is perceived as a potential for either gain or loss, and the potential for loss is weighted more heavily in an individual’s process of mental accounting.

Public Image and Credibility is the final element theorized to hold large influence on why sunk cost bias manifests in investment behavior, that is the desire to preserve reputation or self-image in a public context where commitments to investments may have been made (Tykocinski & Ortmann, 2011). As Walton (2002) argues, it is an “argument from commitment,” when an individual publicly expresses a positive statement, viewpoint, or value then the public assumes they are committed to that perspective (p.489). To step away from that commitment means two things: admitting fault or a mistake and presenting as inconsistent, neither of which are tolerated well by individuals or policy decision makers (Baumeister & Vohs, 2007). As such, sunk cost bias-based decisions are theorized to be a kind of self-justification behavior, a continuation of investment behavior in order to reassert the original investment was the right choice (Mancha & Agrawal, 2014).

As a final note on why this phenomenon may occur, project completion also is cited in some work as being a key outside factor that works in tandem with sunk cost- while this argument will be discussed further in the Counter Arguments section, it is worth also mentioning here (Sleesman, Conlon, McNamara, & Miles, 2012). Proximity to project completion refers to the fact that the closer one is to *completing* a project has additional influences on individual unwillingness to abandon an investment or project. This is compounded by the influence of existing infrastructure that would need to be abandoned to change course- if a building is already 90% built it is much harder to justify walking away from that building. Sleesman et al. (2012) argues that in many studies in relation to sunk cost, this project completion element is not

factored in adequately, and as such impacts are inaccurately attributed to sunk cost behavior. In the context of this study, lock-in is intended to help cover some of this gap, and this critique will be considered throughout the course of research to ensure false attribution potential is reduced.

While sunk cost bias is postulated to be a fairly common phenomenon, there are specific conditions that make it more likely to occur in individuals that should be considered when evaluating if sunk cost is likely to occur or is present in a decision-making process. The primary factors identified by the research are (1) Personal responsibility; (2) Age; and (3) Personal disposition.

Personal Responsibility refers to how much an individual feels *personally* responsible for the investment costs have been sunk into. Several studies have found that if individuals are personally responsible for the decision to invest, they are more likely to continue to persist with that investment (Miller, 2019). Sunk cost bias does, however, seem to still influence individuals who did not make the initial investment particularly in instances where group responsibility was felt, or there was a concern for accountability and public image (Mancha & Agrawal, 2014).

Age has been researched fairly extensively and has been found to have influence on sunk cost particularly when it comes to temporal sunk costs. That is, older individuals have a higher likelihood of prioritizing the present and appear to be less influenced by sunk cost effects (Strough et al., 2014). Time, therefore, is theorized to be seen as a more limited resource “not to be wasted on unfulfilling pursuits” (Strough et al., 2014, p.79). This may have a more limited impact in the context of policy-based decision making but is still valuable to understand in the context of how factors may influence bias effects.

Personal Disposition has similarly been found to have some influence on if an individual is more likely to fall prey to sunk cost bias, largely through optimism and if the individual making the decision is action oriented. With regards to optimism, it is found that if “anticipatory emotions about the successes of a project are positive,” meaning that if an individual is hopeful about the perceived outcome of a project or investment they will have a harder time letting that investment go or accepting its failure (Strough et al., 2014, p.79). Similarly, individuals who are more action oriented have been found to be more likely to let go of the past and step away from past investments than people who are ‘state oriented’ and focus more on the effects of the past (Tykocinski & Ortmann, 2011). While these factors may be difficult to measure in a study, it is useful to understand that individual disposition may have an effect on if this bias manifests from person to person, and that it does not have a universally equal effect.

Counter Arguments to Sunk Cost

Sunk cost is by no means an uncontested theory, and within the literature several critiques about its application and validity that warrant consideration have been raised. The first of these critiques of course has been discussed in the previous section: the way project completion can influence behavior being falsely attributed to sunk cost bias. As mentioned, this will both factor into considerations of data as well as be tempered by the lock-in element of this research.

The second key critique identified in existing literature is that additional transaction costs are not adequately considered when evaluating if it is more cost effective to abandon an existing investment or project, particularly when it comes to policy decisions (Miller, 2019). These transaction costs may be the work required to regain audience trust, the work required to update information, work required to retrain work forces, essentially any additional work outside of the project itself to recover from the abandonment of the investment. In cases where these transaction costs exist, they may outweigh the base financial or systemic benefit to abandoning

an investment. In the case of this research this challenge will hopefully be captured through the lock-in perspective, which is meant to assess external influences and difficulties incumbent in changing away from existing systems, but this limitation must be considered in sunk cost research in relation to political science issues.

Alongside these critiques, there are two alternate theories that may have bearing on the validity of sunk cost as a theory utilized in this study: (1) Organizational theory and (2) Escalation of commitment.

Organizational Theory is a broad theoretical discipline, defined by some as the theory focused on “the organization as an actor” (King, Felin, & Whetten, 2010, p.290) and by others as the theory “of individual behavior within organizations” (Naylor, Pritchard, & Ilgen, 1980, p.1). It is universally agreed to be interested in behavior related to organizations, but done from two separate angles, either from the angle of organizations being made up by people *or* that people exist in an organizational context (Christensen, Lægreid, Roness, & Røvik, 2007). These two angles can be broken into four overarching perspectives: (1) Organizations are simply a nexus for individual transactions; (2) Organizations are defined by the individuals making them up and the social interactions within; (3) Organizational behavior is defined by the context it exists within such as environmental and population drivers; (4) Organizations are actors in and of themselves (King et al., 2010). Within organizational theory, therefore, the question is often *who* is the social actor driving behavior and requiring study- is it the individuals making up the organization? Or is it the organization itself? Or a mix of the two?

The answers to these questions seem to vary based on the context, particularly when considering if the actor being examined is a public or a private organization. Indeed, at present there is much more limited research in organizational theory in relation to political science and the public organization as an actor (Christensen et al., 2007). Public organizations have a few key factors that distinguish them from private organizations: they must consider a broader range of values due to their role to support the community as a whole; they are responsible for a broad range of functions and are influenced by more than bottom line concerns; and they are slower to change than their corporate counterparts due to institutional factors (Perry & Rainey, 1988; Christensen et al., 2007). The public organization has accountability to its citizens first and foremost, and that can influence the way that organization behaves.

The argument incumbent in this theory is that if one considers organizations as actors in and of themselves, sunk cost bias cannot be applied in the same way to an *organization* as it can an *individual*. However, within the waste industry, it appears relevant to consider individual influence in policy and strategy design for two key reasons. The first lies in leadership: it is posited that “strong leadership serves the function of intentionality within organizations” and it is this leadership that guides organizational behavior most strongly (King et al., 2010). Leaders in the industry, therefore, may hold influence on the way strategy develops and their individual perspectives hold relevance. The second element lies in utilizing lock-in as a theoretical support: lock-in theory is designed to fill in the pressures of public expectations, organizational standards, standard operating procedures, and other external structures that may additionally be influencing decision making at the organizational scale. Together, lock-in and sunk cost can be used to cover the nuance introduced in organizational theory. Organizations, after all, are “comprised of individuals who are filled with emotions” and those emotions must also be considered when researching the multifaceted nature of policy and strategic decision making (Beugré, 2018).

Escalation of Commitment is rooted primarily in organizational theory and is defined as “the tendency for decision makers to persist with failing courses of action” (Brockner, 1992, p.39).

It can either be applied to individuals or organizations and is typically caused by four major determinants. These are identified as: (1) Project Determinants which include present risks or uncertainties, if a setback is permanent or temporary, and potential payback from the investment; (2) Psychological Determinants which include if there have been sunk costs, if an ego threat is present, project completion, and the framing of the project status; (3) Social Determinants such as how the public sees the project and how closely it is tied to group or individual identity; and (4) Structural Determinants like external forces resisting change and any agency institutionalization of the project (Sleesman et al., 2012; Staw & Ross, 1989).

Where sunk cost utilizes ‘waste not want not’ as the key phrase when assessing decisions made through that context, escalation of commitment references ‘turning the situation around’ as the key motivational factor- the four determinants are used as a way to evaluate if continued investment can be justified (Staw, 1981). There are several similarities however, both theories suggest self-justification theory as one of the primary guiding forces to investment persistence and that personal responsibility for an initial investment can have significant impacts on the decision to persist (Brockner, 1992; Bazerman, Giuliano, & Appelman, 1984). Both highlight fairly similar justifications for why the phenomenon occurs, and in many cases the end result is the same if sunk cost bias or escalation of commitment are in effect. However escalation of commitment in many cases factors in more external influences than sunk cost does in its determinants and integrates a wider range of complexities to the decision to persist with an investment. By examining *two* theories (lock-in and sunk cost) versus just escalation of commitment, a deeper level of complexity and a more nuanced division between the external and internal factors can be obtained.

3.2.2 Lock-In Effect

As indicated, lock-in theory will be the secondary mode of analysis for this study, acting as the *external* examination point for these change resistances. An important first step is determining what angle to approach these external effects from: either through the lens of path dependency or lock-in, two terms that speak to very similar effects. The primary difference being that lock-in refers to the “current state of things” while path dependency engages with the “constraints that the past puts on present decisions” (Corvellec et al., 2012, p.33). They both, however, consider the web that makes up the systems that society functions within.

Path Dependency: History Matters

For the sake of this study, lock-in will be the theory utilized, however because they are so closely tied it is useful to understand what is being spoken of when path dependency is mentioned. Definitions of path dependency vary over its history: the origins of the theory introduced it as a purely economic and technological development one. David (1985), the originator of the term, defined it as a sequence where “important influences upon the eventual outcome can be exerted by temporally remote events, including happenings dominated by chance elements rather than systematic forces” (p.332). As the theory was picked up by others, it began to expand in its application to more general societal structures, focusing beyond the development of individual technologies to systems and structures that span society. Lovio, Mickwitz, & Heiskanen (2011) therefore propose a more general definition, suggesting “path dependence refers to the fact that ‘history matters’: prior choices place limits on what can be done today” (p.274). Path dependency also, David (2000) proposes, can be either positive or negative, from a positive perspective it is a process that evolves in response to its own history increasing efficiency and support for that system, while from a negative approach it is a trap for processes that are “unable to shake free of their history” leading to fixed outcomes (p.5).

The definition that appears to best represent the key elements of path dependency as found in the literature is from Seto, Steven, Mitchell, Stokes, Unruh, & Urge-Vorsatz (2016), who define

path dependent systems as “those that develop intertidal resistance to large-scale systematic shifts, with resistance to change driven by favorable initial social and economic conditions and the momentum of increasing returns to scale” (p.426-427). Incumbent in this definition are some key factors that can be used to understand the core of the concept: (1) Inertia or ‘a momentum of increasing returns’; (2) A process focus; and (3) A focus on *historical development*. In essence, path dependency discusses the historical build of inertia that leads to locked-in systems: path dependency *leads* to lock-in effects (David, 2000). The history of development caused by path dependency creates a web of systems in the present that must be untangled to recognize what maintains the status quo, locked in as it is.

Lock-In: Systems Maintain the Status Quo

Lock-in, similar to path dependency, has roots in technical development, but that history was more interested in the *systems* built around those technologies than the development path of the technologies themselves (Arthur, 1989). Arthur (1989), one of the seminal authors of the theory, identified that path dependency in technological development leads to the lock-ins of those technologies and that this could lead to the restriction of potential innovation in the future. Similar to path dependency, however, lock-in theory quickly outstripped the confinement to technological development circles, expanding to a more general definition that was cemented by another influential researcher, Unruh (2000), who sought to apply lock-in theory to carbon development, examining the “interlocking technological, institutional, and social forces that can create policy inertia towards the mitigation of global climate change” (p.817). Unruh in many ways set the stage for how lock-in is used in a current context, particularly in an environmental sphere, establishing the concept of Techno-Institutional Complexes as a way to describe these complex webs of systems, defined as the “large physical infrastructures themselves and the managing organizations, institutions and cultural practices that build and perpetuate them” (Unruh & Carilo, 2004, p.1186). This framework of definitions has inspired much of the theory around lock-in after its development, including Corvellec et al. (2012), who defines lock-in as coalitions of industry networks that “lock-in producers, users, and regulators in dynamic webs of technologies, legislation, standards, physical infrastructures, politics, and cultural norms” (p.33). It is this definition that will be utilized as the working base of understanding for this theory in the context of this study.

Within these outlined definitions, a few reoccurring key elements arose that can be used to identify lock-in effects: (1) Interlocking systems or coalitions of networks acting as the web that makes up the lock-in; (2) Self-reinforcing systems or positive feedback loops entrenching lock-in effects; (3) The society essentially being ‘trapped’ by the system webs; (4) The lock-in limiting the potential for innovation; and (5) The focus on the *present state of things*. These factors can be used both to understand when a frame of analysis is better understood as lock-in or path dependency, as well as can help frame how to identify the effect in practice.

Within the umbrella of ‘lock-in,’ theorists have identified a set of subcategories which combine to create an overall societal lock-in. From the literature evaluated, two different frameworks have been identified, the first proposed by Unruh (2002) and expanded by Seto et al. (2016) established three types of lock-in: technological, institutional, and social/behavioral. Corvellec et al. (2012) altered these categories to expand to four primary types of lock-in: (1) Institutional; (2) Technical; (3) Cultural; and (4) Material. In their work, Corvellec et al. (2012) provide an examination of these lock-in subcategories in relation to the waste management system in Gothenburg, Sweden, and upon analysis they provide the appropriate level of detail that is needed for this study. As such this will be the framework expanded on in the case of this research. *Figure 3-5* outlines the nature of these four types of lock-in, with a brief examination of how they may manifest in the waste sector for reference.



Figure 3-5. Types of Lock-In and their Properties

Source: 2019 Corvellec et al., 2012; Seto et al., 2016; Svingstedt & Corvellec, 2017

Using these four categories as a framework can assist with the otherwise too-complex task of evaluating the interlocking, vast networks that make up a locked-in system. These categories may overlap but establishing clear guidelines for understanding can help assist the codification of an otherwise nebulous concept.

Lock-in is theorized to occur for a broad range of reasons, however many explanations can be condensed into a few key explanations. It begins with path dependency, which often originates with the adoption of a technology that is more and more accepted in a society until it “captures a critical mass of the market” becoming the standard in that field (Unruh, 2000, p.820). Once that technology is established as the standard, the processes around the use and development of that technology are improved incrementally to improve ease of management, which naturally leads to a structure of increasing returns (Unruh, 2000). These increasing returns act as a positive feedback loop system- as it becomes easier to generate and use the technology it becomes more and more cost effective to stick with that technology and less and less cost effective to switch to alternatives. Lovio et al. (2011) describes four main reasons for these increasing returns: (1) Significant set-up costs that, once paid decrease the ongoing costs of production with volume increases; (2) The development of knowledge about the technology that, once established, promotes its continued use; (3) Coordination effects where one user experiences increased benefits when others utilize the technology; and (4) Societal expectations for these coordination effects. These factors combined lead to a “snowballing effect, based on learning by doing, learning by using, and learning about payoffs, which quickly makes the technology preferable to others” (Cowan & Hulten, 1996, p.63).

Alongside these increasing returns from technological development comes the co-evolution of supporting systems like infrastructure, policies, and institutions that support that technology.

These techno-institutional complexes are “systems of technologies embedded in a powerful conditioning social context of public and private institutions,” both within and without the industry (Unruh, 2000, p.818). They can manifest in several ways: as inter-industry coordination through forces like design standards, supply chain agreements, and coalitions; as private mechanisms for financing and development; as educational institutions which promote the knowledge around the incumbent technology; as political institutions designed to support the industry as it becomes more established; all combine to create institutional webs that cement the technology as the status quo (Unruh, 2000). These technologies become deeply interdependent with “economic, technical, and political decisions that gradually develop in the economy” leading to an interdependency that cements the technology as an established piece of society (Cowan & Hulten, 1996, p.63).

This is where the lock-in truly sets in, and the reason why it is so challenging to break. Once these systems have been built, their perpetuation benefits those within them, and so several incumbent forces will work to maintain the status quo (Corvellec et al., 2012). The organizations and systems in place are naturally resistant to letting go of this system of increasing returns, setting a firm ongoing trajectory. For businesses, “firms tend to focus preferentially on existing competencies and away from alternatives that could make their present products obsolete” (Unruh, 2000, p.821). For financial institutions, they continue to fund the systems in place rather than investing in risky systems outside the regime. Infrastructure has been created and new infrastructure would need to be proliferated to invest in a changed technology. As such, actors are driven to continue the system, and breaking that motivation is a high challenge.

In society it is not uncommon to have a narrative that highlights history as a continual progression towards improvement, but lock-in theorists point out that this is not always the case. There are many cases where the best technology is not the one that meets all of these criteria and becomes the locked-in force- in truth “there is no guarantee that the ‘superior’ technology...will be the one that survives” (Arthur, 1989). When that is the case, though it is often *extremely* challenging, it may be in society’s best interest to break the lock-in that has been established. Based on the evidence, such may be the case with plastic recycling.

3.3 Summary

3.3.1 Knowledge Gaps

In the review of the available research, a few key knowledge gaps were identified that this study seeks to fill. The first lies in the overlap between sunk cost and lock-in theory, which seems highly relevant in the case of this study. Both theories seek to derive understanding of complex, real world scenarios, and lock-in theory in particular is focused on the societal webs that make up decision making. It is natural, then, that nuanced, multi-dimensional understandings of these decisions cannot be obtained by leaning on just one perspective, just one theory. There is an overlap between individual sunk costs, organizational path dependencies, and broader moral and cognitive investment, and it is here that this study’s interest lies. Obtaining a deeper understanding of both the external pressures, the webs that build up societal trajectory in relation to waste, as well as the internal ties to policies and strategies for those who make them, is necessary in order to comprehensively address the problem at hand.

Limited research also has been done in the region of focus in relation to waste management systems, leaving an opportunity for deeper understanding of how their systems influence the surrounding country and what may be holding them back from more sustainable innovation. This region is well suited for this research, and due to its position on a port and increasing market challenges in relation to selling plastic overseas the need for change is present. This research is intended to support that need.

3.3.2 Framework

For the sake of precision in this study, a narrow definition of sunk cost bias and lock-in have been established through the synthesis of the research presented. This is outlined in *Table 3-1*.

Table 3-1. Framework of Theories

Theory	Definition	Key Terms
Sunk Cost Bias	The heightened tendency to continue a project if money, time, or effort has been invested	Investment, Unrecoverable, Loss, Waste, Risk
Lock-In	The system of networks that locks actors into webs of policies, technologies, physical infrastructures, and cultural norms, restricting innovation potential	Influential systems, restricted development, status quo, positive feedback loop
Institutional Lock-In	Legal and political elements of lock-in	Policies, strategies, regulations
Technical Lock-In	Technological and economic elements of lock-in	Dominant design, markets
Cultural Lock-In	Cognitive and cultural elements of lock-in	Expectations, norms, preferences
Material Lock-In	Infrastructural and physical elements of lock-in	Buildings, facilities, equipment

Source: Tait et al., 2019; Corvellec et al., 2012

Using this set of definitions and key terms as well as an iterative development process during the completion of interviews, a framework was built to analyze common themes and challenges that integrates these two theories into a centralized analysis frame. This categorization model is outlined in *Figure 3-6*, with a more detailed map of the specific codes used to examine internal and external barriers to change in *Appendix 4*. Clarification on the meaning and context behind each code can be found in *Appendix 5*. This frame was utilized to codify interview statements into thematic groups.

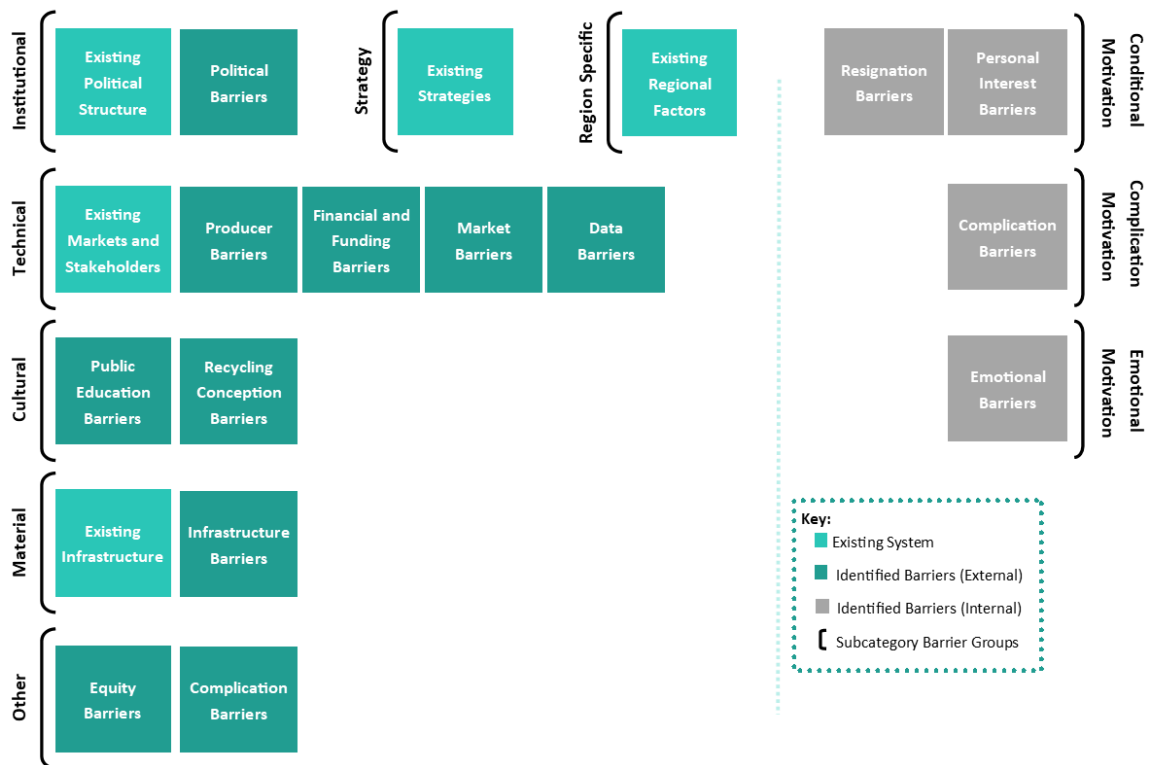


Figure 3-6. Framework of Analysis for Barrier Data

Overall, three primary categories were utilized to consolidate the themes identified in the coding and framework development process: (1) Elements of the Existing System that have led to the entrenched plastic recycling system; (2) Identified Barriers to Change *external* to policy and strategy makers (also referred to as System Barriers); and (3) Identified Barriers to Change *internal* to policy and strategy makers (also referred to as Personal Motivators). Data was also collected regarding a fourth category, Suggested Solutions to try and break existing barriers as identified by interviewees, which will be evaluated briefly in the final section to support potential future research opportunities.

Largely the External Barriers categories (brackets oriented on the left) follow the identified lock-in categories, with two notable additions: Region Specific and Strategy, which were both added to provide regional context for existing system structures based on key elements identified during the interview process. Internal Barriers (brackets oriented on the right) were broken down into three key motivational categories: conditional, emotional, and complication. These categories were identified retroductively by examining the barriers outlined by interviewees and establishing groupings that best fit the concepts that arose.

In order to ensure validity of identified codes, the number of interviews in which the code is mentioned and how frequently it is mentioned in that interview is outlined in *Appendix 6*. It was using these structures and subcategories, interview and case study documents were analyzed and assessed.

4 Findings and Analysis

Through collection and coding of examined interviews and strategic regional documents, the following results were identified. Results have been broken into four key categories, beginning with an examination of the existing system that holds influence over identified barriers, highlighting the most significant influential elements as a foundation for the barriers analysis. This is followed by an examination of External Barriers and Internal Barriers, breaking down the most frequently mentioned barriers in interviews and strategy documents and providing narrative perspectives of how these barriers influence the system and restrict innovation potential. These findings will be integrated into the discussion section to provide application recommendations for results. Finally, Solutions are briefly outlined and examined to provide potential opportunities for future study. While barriers are the primary focus of the data, in order to fully understand how these barriers manifest, it is key first to understand the influential elements that define the system they exist within.

4.1 The Existing System

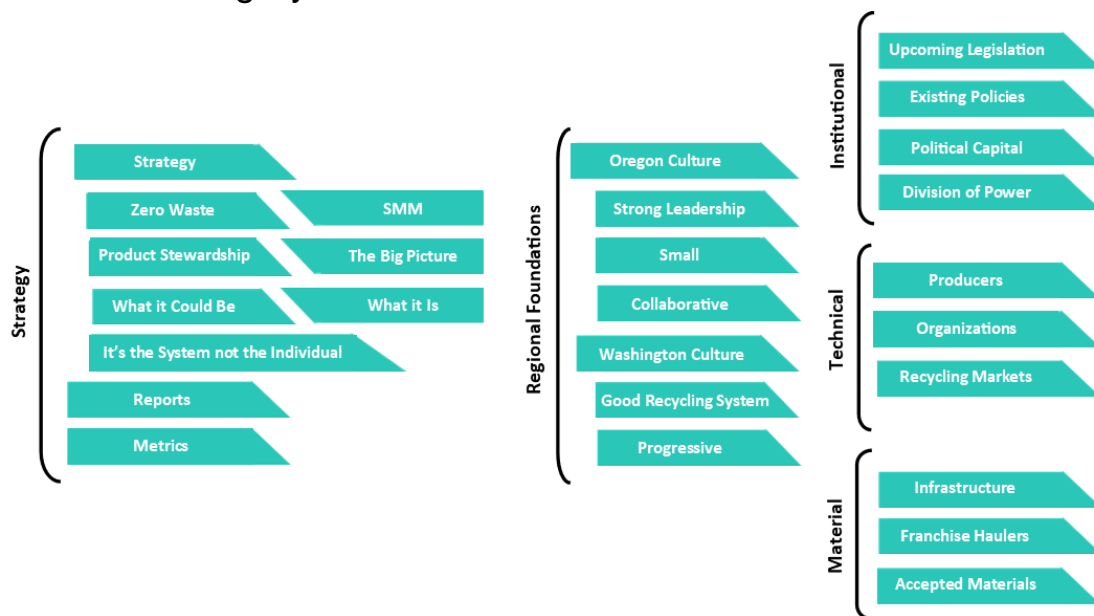


Figure 4-1. Identified Codes for Existing System Category

In the process of understanding the barriers incumbent in the system of examination, some existing system conditions were highlighted in interviews as key to the foundation of the waste structure. The most relevant of these factors were synthesized in Figure 4-1, falling into five categories: Strategy, Regional Foundations, Institutional, Technical, and Material.

The Regional Foundations subcategory links with the Cultural subcategory for 'Lock-In,' and the Strategy subcategory links with the Institutional subcategory, but they have been separated out in this instance for the sake of specificity. Both Regional Foundations and Strategy are utilized only to outline the nuance of the Existing System codes that feed into multiple different other subcategories in later sections.

Within these codes, a few key through lines arose as the strongest foundational elements that inform the plastics recycling issue, as identified by interviewees and strategy documents. Primary among them are the *Strategy* used by the regions to address the issue, which guides priorities and approach to end-of-life management of plastic material.

4.1.1 Strategy

Strategy documents have been drafted at the state, regional, and city level, and these documents can hold bearing on how government bodies and departments develop policies, collection structures, regulations, educational initiatives, hauler contracts, and more. In the case of the two regions of focus, four strategy documents were identified as the best representatives of what drives Seattle and Portland's waste management systems and initiatives. For Portland, it is the state 2050 Vision and Framework for Action (2012) that acts as the primary guiding document, with the regional 2030 Regional Waste Plan (2019) acting as a more focused, comprehensive guide. For Seattle, the primary document that guides strategy is the city's Solid Waste Management Plan (2013) supplemented by the Zero Waste Resolution (2013), with the state's State Solid and Hazardous Waste Plan (2020) acting as a regulatory framework. The two regions have distinctly different strategies, with Seattle promoting a Zero Waste strategy framework and Portland favoring a Sustainable Materials Management one.

Zero Waste is a strategy that focuses on engaging with waste materials as resources by prioritizing prevention, recycling, and composting, with the end goal of completely eliminating waste in the materials cycle (Zero Waste Resolution, 2013). Often referred to as 'cradle-to-cradle,' strategies in zero waste management systems typically include "discouraging products and materials that can only become trash after their use," leading to a prioritization of strategies such as encouraging producers to create recyclable or compostable goods; improving recycling management systems to be able to process more types of material; and increasing reuse, repair, and reduction behavior to reduce the consumption of single use goods (Zero Waste Resolution, 2013, p.B-2). This strategy is strongly present in Seattle's strategy documentation, with Washington state's strategy documentation more high level, focused largely on regulation, technical support, and recycling program development.

Sustainable Materials Management (SMM), as a counterpoint, is focused more on the life cycle perspective, "seeking to reduce environmental impacts by managing materials through all stages of their life" (2050 Vision and Framework for Action, 2012, p.2). SMM is concerned with reducing environmental impacts from production to end-of-life, which in many cases can lead to de-prioritization of recycling and composting as primary strategies when they are not the most important environmental impact point of a product's lifecycle. This strategy is more open to landfilling as a tool and is concerned with "managing materials holistically" (2050 Vision and Framework for Action, 2012, p.2).

Both strategies share some priorities, such as in extended producer responsibility (EPR), which can also be referred to as product stewardship, a management system that requires producers of products to be responsible for the end-of-life management of the goods they create. This strategy is particularly popular with Zero Waste systems, as it incentivizes producers to create materials that can more easily be managed at end-of-life as, depending on the EPR policy, producers become financially responsible for materials that are harder to recycle, harder to sort, and products that have more significant environmental damages (Seattle's Solid Waste Management Plan, 2013). In essence, EPR applies the responsibility for negative externalities incumbent in the solid waste management system to those who create the products that lead to those externalities, creating incentive to reduce those negative costs. As such, while Oregon includes EPR in its strategic framework, Seattle seems to heavily prioritize it as a key tool to achieve strategic goals in relation to Zero Waste.

Interviewees in Washington and Oregon also discuss being focused on *The Big Picture*, but there appears to be a different contextualization of what that big picture *is*. For Oregon that big picture is largely situated in the value chain- concerned with where on the value chain the highest environmental impacts lie and targeting that point of the value chain to address higher order

goals such as reducing greenhouse gas emissions, reducing resource extraction, and managing toxicity. As such every solution should be built in service of that goal, with recycling acting as a tool in service of that larger picture. It is a strategy fixed firmly in the present, finding solutions within the existing system, codified with the term *What it Is*. Key words that were highlighted to exemplify this kind of thinking fell into three themes: (1) accepting hauler perspectives; (2) data focused; and (3) asking if it is really recyclable.

For Washington and especially Seattle, the big picture is more interested in potential, with a focus on what could be and how to bring about that system by creating strategies and policies that push for that potential. As such, solutions are designed to put pressure on system operators, such as haulers and producers, to try and drive change towards better system functioning. This model of thinking was codified as *What it Could Be* and fell into three primary themes: (1) imagination; (2) pushing haulers; and (3) little victories. Some examples of how these differing models manifest from interviewee perspectives are outlined in *Figure 4-2*.

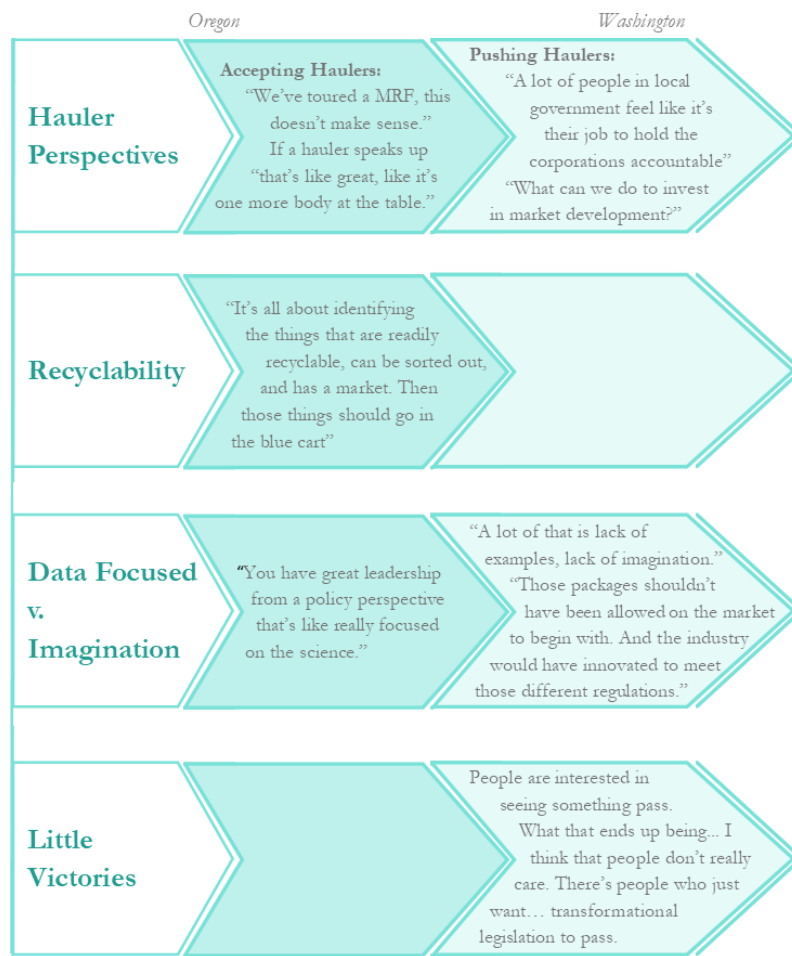


Figure 4-2. Interview Quotes Summarizing Regional Strategy Priorities

There is of course variation in the instances stated in the interviews, as these are entirely individual perspectives, but it provides some context to how these differences may be perceived.

4.1.2 High Influence Factors

Despite these differences, some key commonalities emerged as important system factors. All of these common factors are outlined in *Figure 4-1*, but in discussions and review of strategy documentation five factors stood out as the most important foundations to understand for both systems: *Stakeholders*, *Metrics*, *Existing Policies*, *Accepted Materials*, and *Markets*.

Stakeholders

Stakeholders can have a strong voice in influencing the strategy and priority of government actors-solid waste management is no exception. While a broad range of stakeholders have been outlined in *Figure 1-4*, five key stakeholder groups were identified by interviewees as the largest influencers of strategic decision making and as the highest potential for External Barriers and pressures. These stakeholders are outlined in *Figure 4-3* with a brief summary of the realms they primarily operate in and where they may most exert influence.

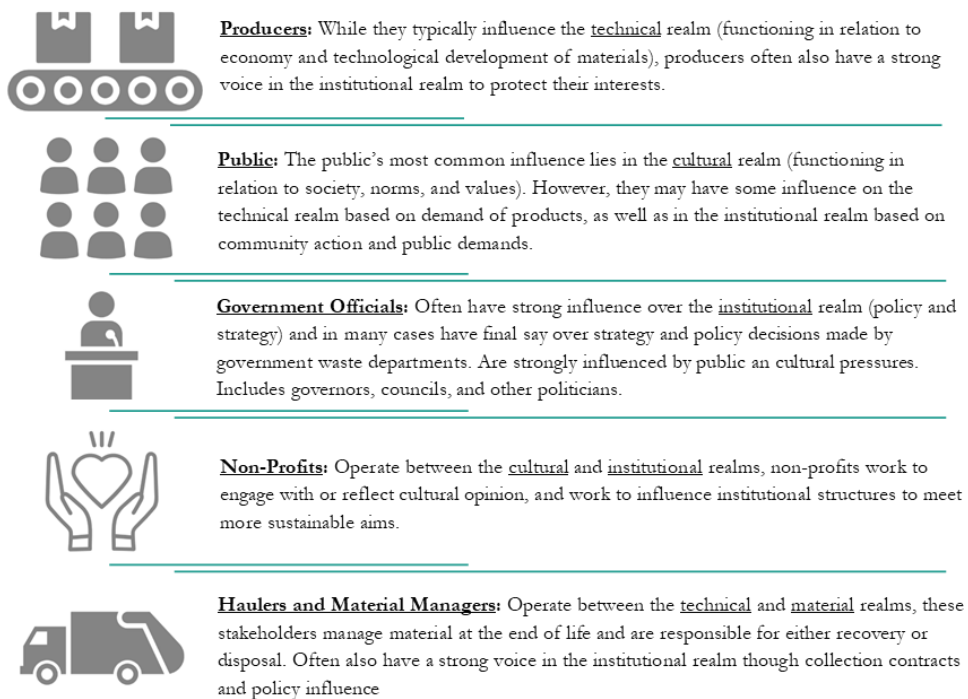


Figure 4-3. Highest Influence Stakeholders Identified by Interviewees
 Source: Boatman, 2021; Ticon, 2021; Conveyor Belt, 2021; Coquet, 2021; Blake, 2021

The most commonly mentioned of these are *Producers*, *Haulers*, and the broader *Public*, all of which are mirrored in the System Barriers category in Section 4.2, highlighting their importance.

Metrics

It is often said that “what gets measured, gets managed,” and as such it is important to understand what is measured and how in the system of analysis. This measurement points to what is prioritized, and what is communicated to stakeholders as important. For both Washington and Oregon, historically three key metrics have been highlighted: Disposal, Recovery, and Generation (2018 Oregon Material Recovery and Waste Generation Rates Report, 2020). Disposal refers to how much material is put into the landfill as well as most incineration practices; recovery refers to what is recycled, composted, sometimes also including incineration for energy recovery; and generation refers to the total tons of material in the waste stream. These three metrics are reflected as the dominant ones in all strategy documents in the region: both city (Portland Recycles! Progress Report and Action Plan, 2017; 2019 Annual Waste

Prevention and Recycling Report, 2019) and state (Waste Generation and Recovery Data, 2017). *Figure 4-4* provides a visual representation of how this information is commonly communicated in such annual reporting.

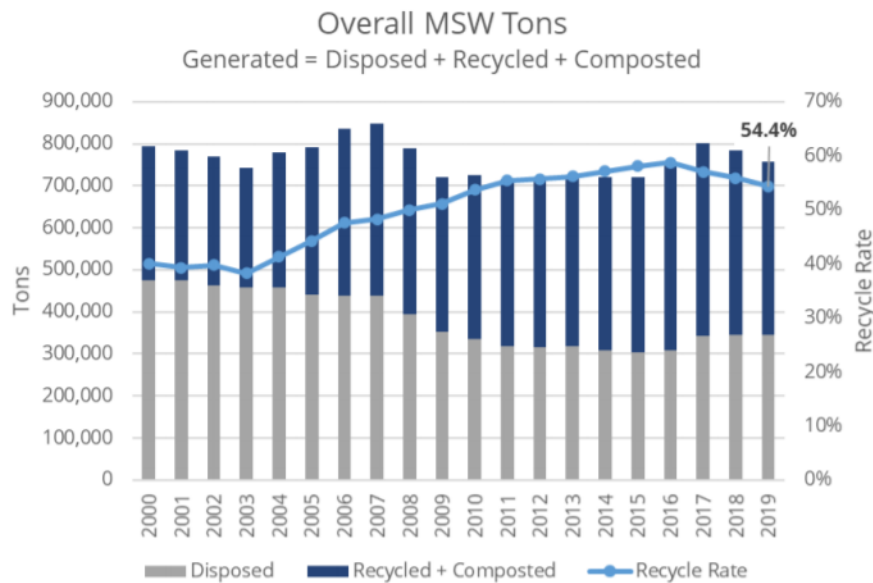


Figure 4-4. Seattle’s Overall Waste Generation, Disposal, and Recovery Rate 2019
Source: 2019 Annual Waste Prevention and Recycling Report, 2020

Beyond these standard metrics, the other more recently emerging metric is per capita generation, outlining the weight of material generated per person within the region covered by the report, providing a more tangible number to understand consumption and waste patterns of residents and commercial actors. All four annual reports also utilize this metric, with some going further to measure the per capita recovery and disposal rates as well.

Oregon’s DEQ also tracks greenhouse gas emissions and reduction resulting from recovery, while Washington’s Ecology works to measure some reuse numbers through reporting from operators like food banks and paint re-processors (2018 Oregon Material Recovery and Waste Generation Rates Report, 2020; Waste Generation and Recovery Data, 2017). Seattle measures other initiatives through textual analysis, providing a 150-page annual report outlining programs that pursue goals that are more challenging to measure in numbers (2019 Annual Waste Prevention and Recycling Report, 2019). However, when considering the *primary* measurement, generation, disposal, and recovery stand as the largest representative at present. As such, *Metrics* is reflected in the External Barriers category in Section 2, acting both as a foundational existing factor that feeds into an identified barrier that locks status quo practices into place.

Existing Policies

The regions of examination already have robust policy structures built around the management of solid waste, and several of these policies are either designed directly to address plastic recycling or influence its management. *Table 4-1* provides an overview of those that appear to be most relevant to this study.

Table 4-1. Overview of Influential Existing Regional Policies Influential to Plastic Recycling

Policy	Level	Region	Description
Opportunity to Recycle Act	State	OR	Sets recycling and reuse program requirements for cities and counties
State Bottle Bill	State	OR	Creates bottle deposit and return system
Rigid Plastic Container Law	State	OR	Sets recycling, reuse, and recycled content standards for rigid plastic containers
Single Use Bag Ban	State	OR	Bans single use plastic bags. Sets fees and requirements for paper and reusable bags
Plastic Bag Ban	City	OR	Bans single use plastic bags. Sets fees and requirements for paper and reusable bags
Single Use Plastics Reduction Policy	City	OR	Requires specific single use plastic items (like straws) be only available upon request
Solid Waste Handling Standards	State	WA	Regulates solid waste and hazardous waste management facilities and activities
Reduction and Recycling, Dispositions Revised Code of Washington	State	WA	Sets regulations and requirements for regional recycling programs
Single Use Plastic Bag Ban	State	WA	Bans single use plastic bags. Sets fees and requirements for paper and reusable bags
Plastic Bag Ban	City	WA	Bans single use plastic bags. Sets fees and requirements for paper and reusable bags
Recyclables in the Garbage Ban	City	WA	Bans the disposal of recyclable or compostable items in the garbage
Single Use Plastics Ban	City	WA	Prohibits the sale of specific single use plastic items (like straws)

Source: *Opportunity to Recycle Act, 2021; Oregon's Evolving Bottle Bill, 2021; Rigid Plastic Containers, 2021; Single Use Bag Ban, 2021; Plastic Bag Ban, 2021; Single Use Plastics Reduction Policy, 2021; Solid Waste Handling Standards, 2018; Solid Waste Management, 2020; Single-Use Plastic Bag Ban, 2021; Bag Requirements, 2021; Washington's Collection and Disposal, 2021; Straws and Utensils, 2018*

Other policies that relate to plastic recycling exist within these legal systems, however the policies listed in *Table 4-1* were most frequently listed as influential during the interview process or in strategy documents. As such, while they are not totally representative, they act as a lens into what legislative priorities and precedents may have been set.

This list of policies reflects the balance of influence evident in these two regions- in Washington, the Department of Ecology takes a more regulatory role, acting as a standardizer and centralizer more than an innovator, while Seattle is key to pushing more dynamic legislation initiatives in recycling. For example one interviewee detailed, with the plastic bag ban, the state implemented their law only after several cities had created their own “so you don’t have 36 ever so slightly different interpretations...to make it more uniform.” In Oregon, DEQ has a stronger influence, providing more involved legislation that influences regional systems and sustainable direction. “I think a lot of the innovation is happening at the state level and is kind of pushed down to the local governments” another interviewee shared, highlighting the difference in structure.

It is also valuable to note that plastic management has been forced to change drastically from 2018 due to the implementation of China National Sword, as exports to China and other Asian countries became more restricted, influencing materials markets, data requested from recyclers, residential hauling rates, and some regulation pathways to ensure materials are managed appropriately. This development also of course has begun to effect what materials are accepted for at all, another influential factor in the existing system.

Accepted Materials

The plastic materials that are accepted in a regional system can be influenced by several different factors, in this case most significantly materials lists are influenced by what is considered recyclable (Oregon's statewide priority of recyclable, collectable, and marketable versus Washington's priority of pushing innovation). *Accepted Materials* are also partially influenced by *Existing Policies*, as Oregon's bottle bill leads to the source separation of most bottle materials, and so in most cases that material is removed from the commingled system in the region. As one interviewee shared, more recently changing export markets have influenced some materials being removed from those lists, including plastic bags for the City of Seattle.

Beyond these differences, the largest disparity between the two systems is that Washington does not have a statewide list, making for an accepted materials list that varies depending on city or county, which can increase contamination rates and regional confusion. In Seattle, this has led to a more expanded collection list, including plastic clamshells and plastic lids that are 3" or wider, items that Oregon has left out entirely (Collection and Disposal, 2021). The largest difficulty in this is that removing a material from a list when it is found not to be recyclable can be much more challenging than not adding the item in the first place- as such it is valuable to know the jumping off point for each system. For Portland, the list is statewide and less robust, including only plastic bottles, jugs, jars, 'tubs,' nursery pots, and buckets (Garbage and Recycling, 2020). For Seattle, this list is city specific and slightly more complicated, accepting the same materials as Portland but with the additions of lids, plastic cups, and clamshell containers.

Markets

Market influences do not just hold bearing on what materials can be accepted for recycling, but also can influence funding for waste management systems, regional customer charges, and viability of recycling systems. In interviews, two key elements to markets arose: (1) falling recycling commodity prices lead to challenges paying for waste management programs; and (2) developing export markets leading to the increase of residential rates.

Falling Commodity Prices: "The plastic recycling rate today is the lowest that it's been in ten years" an interviewee stated, continuing that "despite all this strong demand from brands for PCR it's not manifesting in sufficient market pull. Virgin plastics are just too cheap." Data from SPU's Residential Survey Market Prices report (2019) confirms this, showing that recycled plastics markets are at the lowest they have been in the past ten years, taking a particularly steep dive in 2018. In 2011, recycled plastic was sold at \$473 per ton, oscillating between \$400 - \$500 per ton between 2011 and 2017. However, in 2018, plastic prices dropped to \$320/ton, following to \$286/ton in 2019 (SPU Residential Service Market Prices, 2019). Plastic is not the only commodity that has suffered a drop in value, paper in particular has followed a similar trend, with mixed paper at the lowest price it has been since 1993, dropping from \$75/ton in 2017 to \$0.83/ton by 2019. Cardboard went from \$142/ton in 2017 to \$40/ton in 2019 (SPU Residential Service Market Prices, 2019). While aluminum and glass stayed at fairly steady prices, these drops for plastic and paper products have influenced funding for recycling systems, leading to the necessity to consider different development paths and the need to raise residential rates.

Developing Markets and Raising Rates: "The biggest thing is our residential rates went up by a couple bucks a month...because it costs more to process the materials" an interviewee shared when asked about the last few years. "There's outrage, people are frustrated" they continued, highlighting that consumers being forced to absorb costs of the recycling system degrades public trust and challenges the ability of the recycling system to function, leading to potential barriers to future development.

4.2 System Barriers

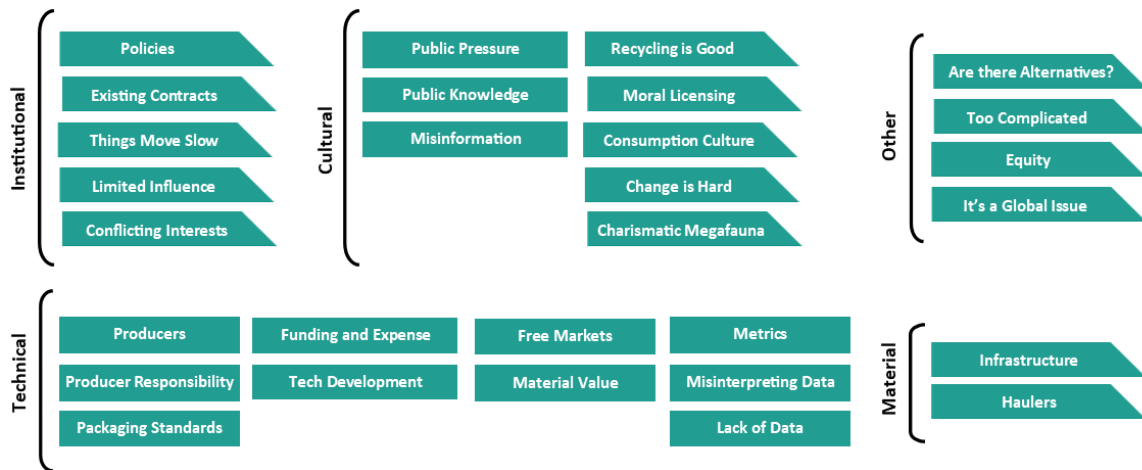


Figure 4-5. Identified Codes for System Barriers (External Barriers) Category

With the establishment of existing systemic factors, interviewees provided a detailed picture of how those elements and others interacted to lead to a wide range of system barriers preventing change, outlined in *Figure 4-5*. These elements, alongside a history of development, helped guide the cultural and systemic structures that make up the solid waste management systems in the regions of analysis. In order to understand these barriers, they have been broken into 5 subcategories: (1) Institutional barriers; (2) Technical barriers; (3) Cultural barriers; (4) Material barriers; and (5) Other barriers.

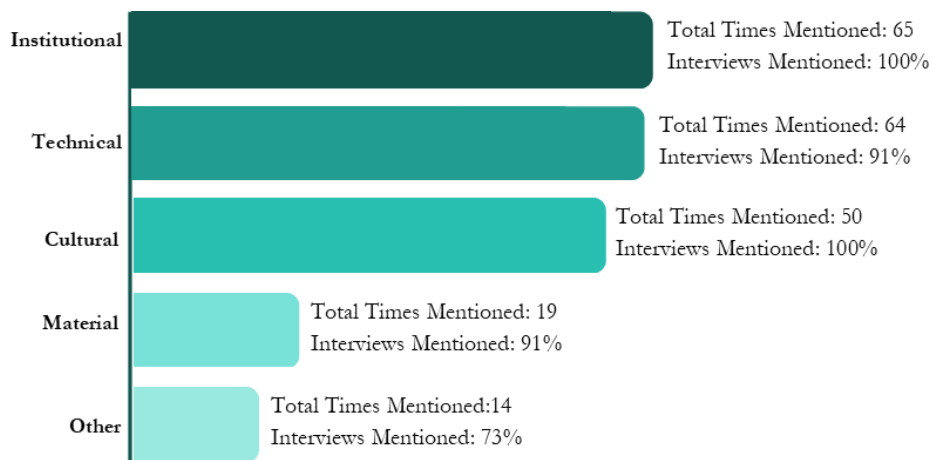


Figure 4-6. Frequency External Barrier Subcategories Mentioned in Interviews

These barriers are discussed in order of the degree to which they were discussed in interviews and strategy documents, in order to gain a stronger understanding of which subcategory may be the most pivotal in the issue. An overview of this frequency can be found in *Figure 4-6*, with more detailed breakdowns provided in *Appendix 6*.

4.2.1 Institutional Barriers

Institutional Barriers can be summarized as legal and political barriers, covering issues related to policies, strategies, and regulations.

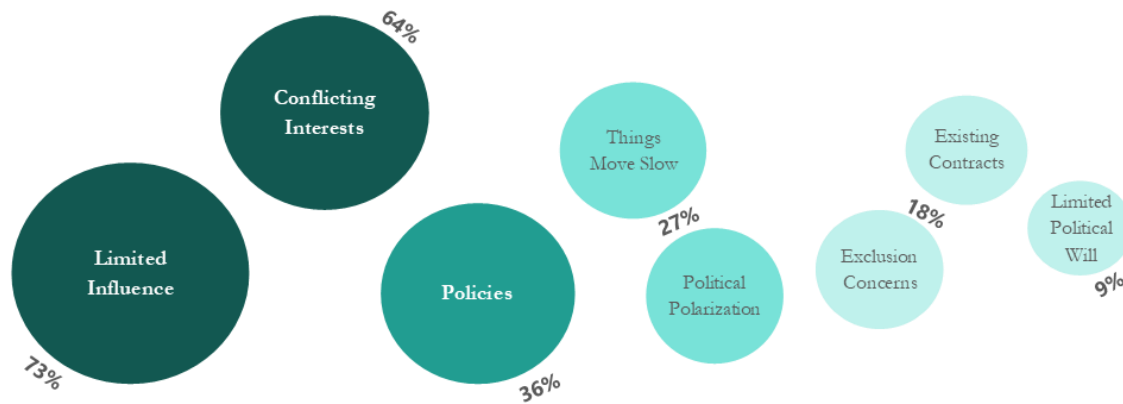


Figure 4-7. Percent of Interviews that Discussed Institutional Barriers

Institutional Barriers seem to largely be broken into two key groups- Policies, defined by legislation and contracts that are in place as well as standard political practice which may act as a limiter, and Established Players, defined by the stakeholders present in the system and how they may be resistant to introduced changes. *Figure 4-7* provides an overview of the barriers identified in the Institutional Barriers subcategory, with the percentage of interviewees that mentioned each barrier highlighted in grey, demonstrating which barriers were found the most universally relevant.

Within the world of solid waste management, government agencies act as the establishers of state, regional, and city strategy and plans. Strategic decisions are guided by relevant stakeholders such as the public, who agencies often are responsible to; government actors like councils, governors, or mayors; industry interests such as waste haulers; environmental non-profits; and producers who may be resistant to changes that influence their ability to operate within regional limits. Once in place, however, strategic frameworks and policies can guide educational messaging (informing public opinion, values, and knowledge); what is qualified as success (goals and targets and therefore also what is measured); how haulers operate, what they accept, the facilities they manage, and the structure of contracts; how producers can interact with regional markets- the list is an extensive one ranging across all other barrier subcategories. Due to how many stakeholders are involved with development and how many are impacted, however, policies can also be slow and difficult to change. One interviewee emphasized this point, stating that, “it’s really hard to have that political support to make state law changes”. As such, the establishment of specific policies or strategic directions can be difficult to move away from once they are locked-in to. It is therefore reasonable institutional barriers were the most referenced challenge by interviewees.

Of these barriers, two arose most frequently as focus points, demonstrated in *Figure 4-7*: (1) *Limited Influence* that city, regional, and state actors have and how that restricts them from being able to make the changes needed and (2) *Conflicting Interests* of the stakeholders involved with the recycling industry and how these interests stymie change away from established systems.

Limited Influence was the most frequently mentioned barrier, with 83% of interviewees in Washington and 60% of respondents in Oregon highlighting it as an issue of concern. Both DEQ’s 2050 Vision and Framework (2012) and Seattle’s Solid Waste Management Plan (2013)

emphasize that while end-of-life has import, “starting as far upstream as possible- in resource extraction, design, and production- offers the best opportunities to realize the vision of a sustainable society” (2050 Vision and Framework for Action, 2012, p.8). However, the further upstream focus is applied, the more challenging it becomes to influence for many working in the solid waste management field.

“It gets really big really quick” said one interviewee, highlighting the core of the problem, “it’s just that it’s really hard to have something actionable at our level.” They, along with others, referenced the solutions that would be needed to address the core of the plastics problem beyond recycling- changing a national culture of consumption, altering the practices of producers that operate on a global stage, from a regional or state level it quickly becomes inaccessible. “We can do campaigns for our residents about reuse, donating, and things that encourage circular economy” another interviewee shared, “but yeah, our sphere of influence on that big level gets smaller.” In a system so fundamentally reliant on national and global influences (international markets, global producers, national culture) it is the high level that needs to be interacted with to implement change.

Conflicting Interests was the second most cited barrier, with 83% of Washington and 40% of Oregon interviewees citing it as a concern. These conflicting interests are highlighted to have influence in many different arenas: in what conversations can be had among industry groups, how policies are formed and finalized, even how reports are communicated. Producer and hauler interests were often cited as the most dynamic in this barrier, though non-profits and governmental organizations were also discussed as other voices that add to the complication.

“How can we make it so that we’re actually educating and providing stuff but not making too many groups mad?” one interviewee queried while discussing inter-industry event coordination, highlighting how conflicting viewpoints can stymie conversations towards change. Between the stakeholders outlined in *Figure 4-3*, with so many conflicting motivations, it follows that various strong perspectives wish to have their voices represented, creating a dynamic landscape to navigate that limits the ability to discuss innovative changes that may threaten a vital stakeholder. “There’s private interests that pressure us into not talking about it,” and interviewee shared when asked what was holding back discussion about changing focus away from a ‘recycling-first’ strategic mindset.

Representing various viewpoints becomes even more contentious in regard to policy development- “it’s easier to have someone compelled to say ‘yeah EPR makes perfect sense’” a different respondent commented, “but then when you talk about passing the legislation the devil is in the details, [there is always] nitpicking over every little nuance of the approach.” Many interviewees discussed the challenge behind finding consensus, and how bills lose efficacy when they work to make every stakeholder happy, a common challenge in sustainability policy development. Haulers in particular were brought up here, as franchises and contracts are lucrative, and in many cases keeping things as they are is more comfortable than proposed changes that would impact their bottom line. “There is a high degree of concern within the waste community” one respondent stated when discussing how haulers and materials managers approach the introduction of transformative EPR legislation, “and they’re afraid it’s going to lead to a corporate takeover of their industry.”

4.2.2 Technical Barriers

Technical Barriers can be summarized as technological and economic barriers, including issues related to design, markets, funding, and available knowledge.

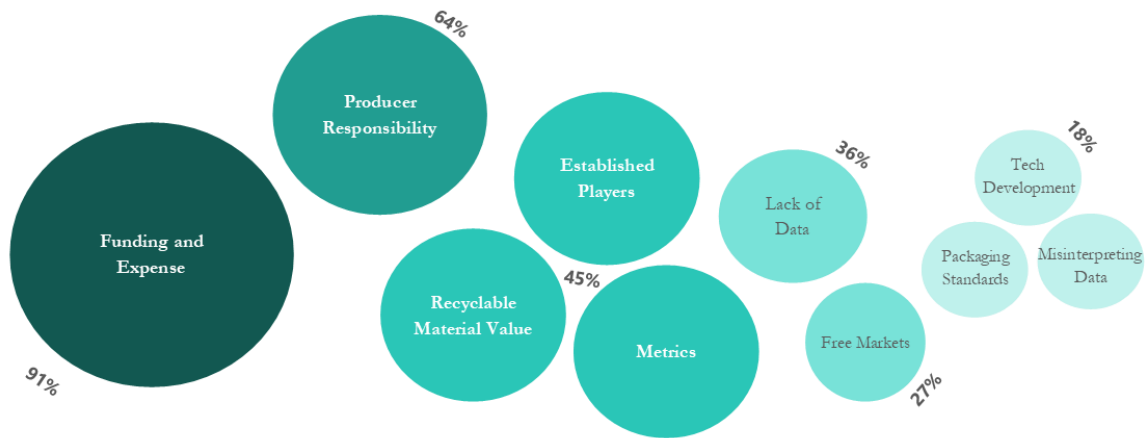


Figure 4-8. Percent of Interviews that Discussed Technical Barriers

Technical Barriers can be consolidated into a few key groups, primarily relating to producers; funding and costs; materials markets; and the accessibility and presentation of data. Within these, two barriers arose as the most commonly stated as issues of concern as can be seen in Figure 4-8, which outlines the barriers most commonly mentioned in this category. These prevalent barriers were found to be: (1) *Funding and Expense* and (2) *Producer Responsibility*.

Funding and Expense encompasses the cost of and available capital to implement changes and was the largest barrier identified in this subcategory by a significant margin. In fact, of the External Barriers, this was the most commonly mentioned concern, discussed by 80% of Oregon and 100% of Washington interviewees. The concerns with funding boil down to a few issues, starting with the fact that funding for waste management operations in the regions of concern rely on less sustainable processes to remain operational. Primary of these is landfill tipping fees, as recycling and composting programs are either provided to the public for free or at highly discounted rates to promote more sustainable waste behaviors.

While plastic recycling does not act as a funding source, solutions that would support improvement of the system and step away from a recycling only model like prevention will also affect material landfilling rates, which causes hesitation when it comes to funding new programs. “Counties and cities finance waste management through tipping fees and subscriptions, and waste prevention happens before things become waste” one interviewee stated, succinctly highlighting the Catch 22 of sustainable waste management.

Not only this, but alternatives to current structures are not without expense. “Accountability, transparency, using recycled content, these things are more expensive but required to achieve circularity” provided one respondent. Everything comes at a cost, and new innovations often come at a higher cost than the status quo as they have not yet been established with the value chains, production lines, markets, everything that is required to create a standardized process. “There’s probably some cool innovations we could do” another interviewee confirmed, “but it’s probably expensive and virgin material is so cheap...that’s a tough, expensive thing to sell to a politician.”

Producer Responsibility was a second commonly mentioned concern in this subcategory, however there was regional variation in the identification of it as a priority- 100% of Washington interviewees identified it as a concern, but only 20% of Oregon interviewees did the same. This is likely due to the difference in strategic priority between the two regions, as Washington has been identified to have highlighted EPR as a core solution for addressing recycling and waste issues. This issue naturally ties in with the *Limited Influence* barrier, as many interviewees pointed out that producers often apply pressure to *resist* accepting further responsibility as at present. “I mean, I can design a product that’s easy to produce but might be really difficult to recycle” one respondent explained, “but as a designer I don’t face those costs, and as a company I don’t see those costs unless I have responsibility for the end of life.” As such, the negative externalities for any waste generated from producer materials is adopted by the public and the government, which does not incentivize producers to change the materials they create or work towards improvement.

“Holding producers responsible and pushing that side of it...[that] is really where we need to go in the United States” an interviewee outlined, mirroring the sentiments of many of their peers. Without producer changes, according to most interview perspectives, progress towards better management cannot be made. However, as mentioned in the Institutional Barriers- there is still resistance on the side of the producers, and it can be difficult for regional governments to force past that resistance to change.

4.2.3 Cultural Barriers

Cultural Barriers can be summarized as cognitive and cultural societal elements that act as barriers, including issues related to expectations, norms, and preferences.

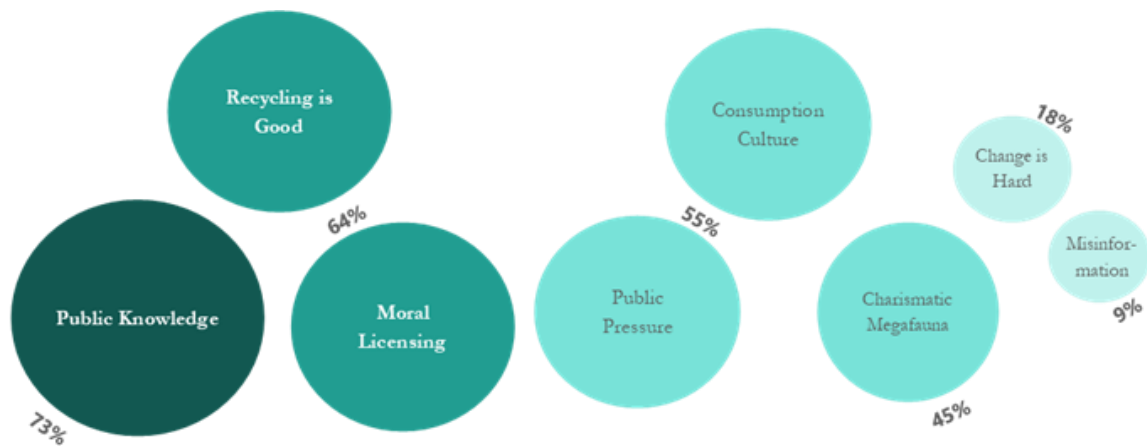


Figure 4-9. Percent of Interviews that Discussed Cultural Barriers

Cultural Barriers fall into a couple key groups, broken up between public education and the recycling myths, i.e. the way recycling is perceived in societal structures and how that perception influences expectations. The focus of this examination is not public *behavior*, in fact many interviewees articulated that the problems lie in the system, not the individual. Instead the focus of the barriers in this section largely revolve around how the public’s impression of recycling influences and puts pressure on decision making and strategic design for policy and strategy makers, informing the directions the pursue.

One unique barrier warrants explanation in this instance, *Charismatic Megafauna*, which is a commonly used phrase in conservation circles to refer to species such as wolves or tigers that are appealing to the broader public and promote attention towards conservation acts, but can

distract from other, less attractive species that are in greater danger of extinction or harm (Barney, Mintzes, & Yen, 2010). In the case of environmental legislation, it appears that some strategies can have similar effects- policies like recycling are publicly attractive and can draw support and backing to sustainable causes due to that popularity, but may draw attention away from other, less visually appealing strategies such as reduction. *Figure 4-9* provides an overview of all of the barriers identified in this subcategory with the most commonly mentioned barriers being: (1) *Public Knowledge*, (2) *Recycling is Good*, and (3) *Moral Licensing*.

Public Knowledge was highlighted as the most significant barrier in this category, with 60% of Oregon and 83% of Washington interviewees highlighting it as a challenge. *Public Knowledge* is closely tied to and can often lead to *Public Pressure*, which has also been highlighted as a key challenge, as what the public knows about the solid waste stream informs what policies, infrastructures, products, and practices they call for. One of the largest challenges with *Public Knowledge* is that the complexity required to address the plastic waste issue is challenging to impart to public audiences. “If you want a collection it has to be simple, it has to be straightforward” an interviewee commented. “They want sound bites, they want easy” another interviewee said, “and we’re not always able to do that, or do that in a meaningful way.”

“We’ve done a really terrific job of ingraining the public that call of ‘recycle, recycle, recycle’ an interviewee commented, “but it was without a really good understanding of all the nuances there.” Where ‘recycling is good’ can fit that need for easy, many interviewees agreed that conversations like reduction and reuse were much more challenging to have- “that’s a really, really tough one to try to get people to change.” This difficulty behind knowledge creation and cultivation around more sustainable behaviors makes it difficult to undercut or alter the ingrained education around recycling-first rhetoric, particularly as simple messages stick much more easily than complex concepts.

Public education and knowledge initiatives can also lead to the mythos surrounding recycling, and as such lead to the public beliefs that fuel the *Recycling is Good* and *Moral Licensing* barriers. These barriers are closely intertwined and were highlighted as the second most prevalent cultural barriers. These factors combine to create cultural pressure points that demand more recycling. That demand puts pressure on government, producers, and others to drive ongoing recycling systems.

Recycling is Good was discussed by 60% of Oregon and 67% of Washington respondents, emphasizing a strong recycling ethic in society creating a cultural attachment to the practice. “How do we build a prevention and reuse ethic that is as strong or even displace it?” an interviewee asked, highlighting in particular how much *time* has been spent building up this culture of recycling.

This cultural mythos has led to what one interviewee referred to as an ‘addiction to recycling’. “People who consume a lot but are well intentioned don’t want the impacts of their consumption to have negative impacts” another interviewee said, reflecting a statement that was shared in many discussions, “so they think recycling more is the answer, because we’ve said that is the answer for many years.” Breaking that belief, that more recycling is better and that recycling is always the answer, is a difficult challenge to meet, made even more difficult by what that belief *leads* to in *Moral Licensing*.

Moral Licensing was mentioned equally as frequently, with once again 60% of Oregon and 67% of Washington respondents introducing its significance. As discussed in section 3.1.1, recycling has in many cases become a substitution for other more sustainable behaviors like reduction,

leading to a public reliance on recycling to relieve guilt around consumption. “It’s the easy thing to do” one interviewee said of plastic recycling, “it’s the cop-out.”

This easy ‘get out of jail free’ card leads to a public reliance on recycling that is hard to break, even when it is not working. It is a question of, in the words of one interviewee, “how [we can] fix the public perception that plastic recycling is no longer the eco-consciousness pass of consumption.”

4.2.4 Material Barriers

Material Barriers can be summarized as infrastructural and physical structures that act as barriers, including issues related to buildings, facilities, and equipment. In the case of the waste management system, this most often refers to existing infrastructure such as sorting technology, material recovery facilities, landfills, and transfer stations as well as collection tools such as containers and collection vehicles.

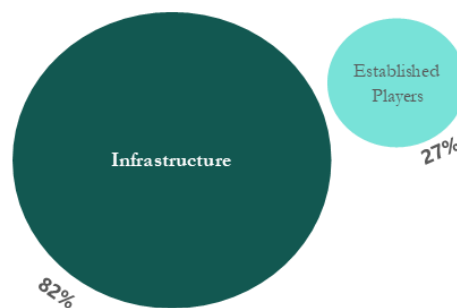


Figure 4-10. Percent of Interviews that Discussed Material Barriers

Material Barriers were discussed to a more limited degree, and only two barriers were introduced by interviewees as outlined in Figure 4-10: (1) *Infrastructure* and (2) *Established Players* who own existing infrastructure, such as waste haulers or MRF operators. To match this limited number of relevant barriers, this subcategory was highlighted the least frequently after the other three lock-in subcategories.

Infrastructure was highlighted most commonly in this subcategory, discussed 60% of the time by Oregon and 100% of the time by Washington interviewees. Key to this discussion is that investment has already been made in recycling infrastructure, and so it is a challenging sell to move away from that investment. “We already have all of this investment...[in] the infrastructure and the messaging and the system” an interviewee shared, “we’ve invested decades and decades into this system and the infrastructure that supports.” Trucks, recycling carts and dumpsters that have been provided to every customer, material recovery facility sorting infrastructure, education fliers of accepted materials, any time a change is made to the system these things are forced to adapt at a large cost. “You know” a second interviewee said, “if you have already invested in something...assuming you’ll be able to pay it off over a five, ten, twenty-year period, you can’t just walk away from that.” As such, any change away from the existing system, the one that prioritizes recycling as the universal solution, can threaten that investment, particularly as infrastructure for reuse, repair, or prevention does not currently exist—“there’s no big framework for waste prevention,” a third interviewee imparted. Any infrastructure to support these initiatives is currently small and hyper regionalized, leading to challenges combatting larger, wide reaching recycling structures already in place.

4.2.5 Other Barriers

Other Barriers are elements identified by interviewees as key to the plastics recycling issue that did not adequately fit in one of the four identified lock-in barrier categories.

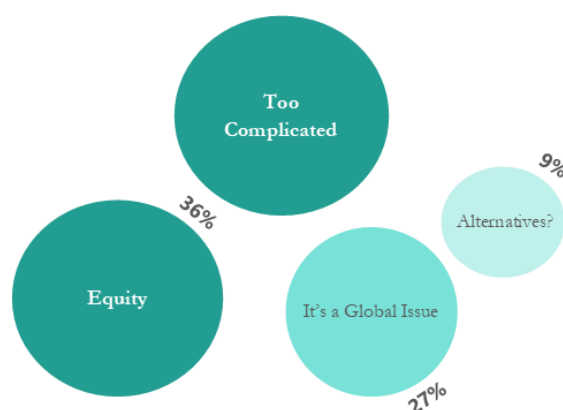


Figure 4-11. Percent of Interviews that Discussed Other Barriers

Other Barriers fall under two primary subcategories: equity issues and complication challenges. Figure 4-11 provides an overview of the barriers identified under the category, highlighting the most frequently mentioned barriers in this subcategory of: (1) *Equity* and (2) *Too Complicated*.

Equity was brought up frequently as vital to create durable solutions, with 40% of Oregon and 33% of Washington interviewees introducing the topic. “Until we get an awareness of the deep impacts of environmental racism and environmental justice we’re not going to be able to build the coalitions we need” said one interviewee. Inequity effects many stages of the waste management process, as identified by Metro’s 2030 Regional Waste Plan (2019), which highlights the presence of inequity in workforce diversity, procurement of hauling services, and information access, all of which need to be addressed and considered in order to truly fix the current system. Without this equity, the waste system will fall short of understanding and addressing the *totality* of public needs, instead over-serving some populations while under-serving others, falling short of social sustainability that supports the needs of the full population the system is designed to serve. This adds further complication, and alongside the other myriad of listed barriers leads cleanly to the other most mentioned barrier in this category.

Too Complicated refers to the complicated nature of navigating alternative solutions and stepping away from existing structures and was mentioned as a challenge by 40% of Oregon and 33% of Washington respondents. This concept is easily reflected by the barriers outlined above, each intersecting with one another, each influencing the other leading to a web of challenges, barriers, and potential solutions that is difficult to navigate both for policymakers and for the stakeholders they engage with. “We want people to maybe buy less to begin with, or buy cyclical products that can be refilled, or buy concentrates, or buy packages that are better than competing packages” an interviewee outlined, “and so all of a sudden you’re in this nuanced conversation where it gets really easy for the public to throw up their hands and say this is too complicated.” This is reflected in politicians too, particularly if there is public pushback demanding more recycling, a simpler solution that is easier to engage with. “Everything is complex and people want simple, and so they’ll grab onto the simple things because they want to avoid the complex” one respondent concluded, “that makes it tough sometimes.”

4.3 Personal Motivators

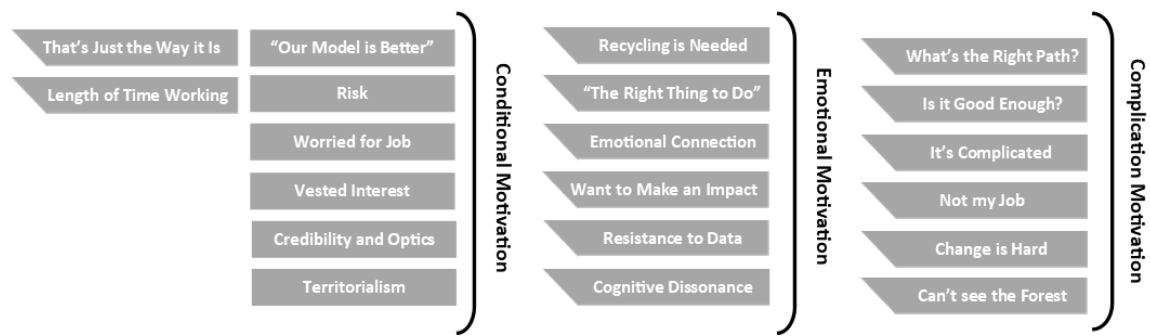


Figure 4-12. Identified Codes for Personal Motivators (Internal Barriers) Category

To add further complication, External Barriers were not the only identified limiters to change, Internal Barriers were as well. These barriers refer to personal motivators or drivers for policy and strategy makers that may influence the strategic pathways they choose to pursue. Figure 4-12 provides a full list of barriers identified within this category. Though initially sunk cost was expected to be the primary frame through which to analyze these barriers, it was instead found that sunk cost did not fit the barriers that arose adequately, so alternate subcategories were identified. Further discussion on sunk cost will be engaged with in Section 5.2.1.

Instead, the several personal motivators identified in interviews fell into three primary subcategory themes: (1) Conditional Motivation which is defined as conscious motivations that are either related to vested interests, such as maintaining ones job and reputation or resignation to the current condition of things; (2) Emotional Motivation which is defined as motivations that are related to an emotional tie to the concept or practice of recycling; and (3) Complication Motivation which is defined as motivations that are tied to uncertainty related to changing course.

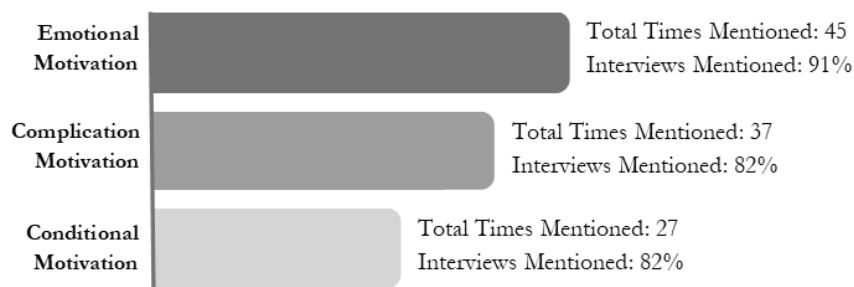


Figure 4-13. Frequency Internal Barrier Subcategories Mentioned in Interviews

Figure 4-13 provides an overview of how frequently each subcategory of motivation was discussed in interviews, highlighting Emotional Motivation as the most prominent barrier discussed, with Complication mentioned second most frequently and Conditional outlined the least frequently of the three. Analysis of these barriers is presented to match this identified order of priority, beginning first with Emotional Motivation.

4.3.1 Emotional Motivation

Emotional Motivation was the most frequently mentioned subcategory of Internal Barrier, made up of barriers that relate to policy and strategy maker personal connection to the concept and practice of recycling. It is characterized by personal connection, a desire to do the right thing, and a struggle with the reality that recycling is still a necessary tool, which creates complication relational to these feelings.

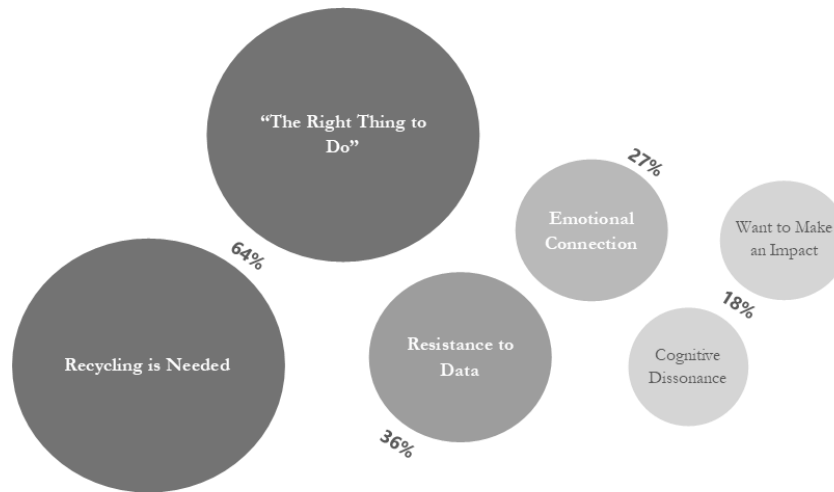


Figure 4-14. Percent of Interviews that Discussed Emotional Motivation Barriers

Emotional Motivation is perhaps the most challenging to identify, as it is the most nebulous, as well as the most personal. Tied to factors like personal values, morals, and ethics, the cognitive dissonance that arises when these are challenged can lead to resistance to the data rather than the changing of personal values and beliefs. Figure 4-14 provides an overview of all internal barriers identified within this subcategory, with two internal motivation categories noted as the most relevant: (1) the belief that recycling is *"The Right Thing to Do"* as well as (2) the knowledge that *Recycling is Needed*.

Recycling is Needed was mentioned by 60% of Oregon and 67% of Washington interviewees. In many ways it ties into the challenges that arise with both the external *Too Complicated* barrier as well as the internal *It's Complicated* barrier but was placed in the Emotional Motivation subcategory due to how this knowledge seems to complicate and intensify emotional connection. For example, when discussing efforts to inform industry professionals of the failings of plastics recycling, an interviewee shared that the response was immediate rejection—"it's like, how are you telling me that recycling doesn't matter?"

"I think there's no doubt that it is distracting" one interviewee commented, "but I think that distraction is unavoidable...because we don't want to stop curbside recycling." As such, it becomes necessary to grow comfortable with the complication, with the lack of a distilled strategy, something which individuals can struggle with.

This challenge, the knowledge that recycling is *needed* but is not enough, can lead to difficulty with internal motivation, particularly when one is emotionally tied to their work. "I think down deep everyone is on the same page who is in this field" said a respondent, "we're trying to protect the environment."

"The Right Thing to Do" emphasizes that motivation, with 60% of Oregon and 67% of Washington respondents introducing it for discussion. This barrier is closely tied with *Recycling*

is *Good* but is more focused on the specific conception of recycling being *morally* correct. Applying ethical value to recycling creates more of a connection to the practice, making it difficult to move away from. “We want to do good” an interviewee said as a part of their discussion about why some are stuck on recycling-first strategy “we have an image of what that means, and we’re going down that path.”

This has led to strategies that are hard to break, and because that belief in recycling persists, the desire to break those strategies is not always there. “We want to believe and we are invested” said one respondent, “we are emotionally invested and our identities and our egos are invested in ‘we’ve done the right thing.’”

4.3.2 Complication Motivation

Complication Motivation is defined as motivations that are tied to uncertainty related to changing course and can be tied to statements of overwhelm, uncertainty, and concern about how to proceed.

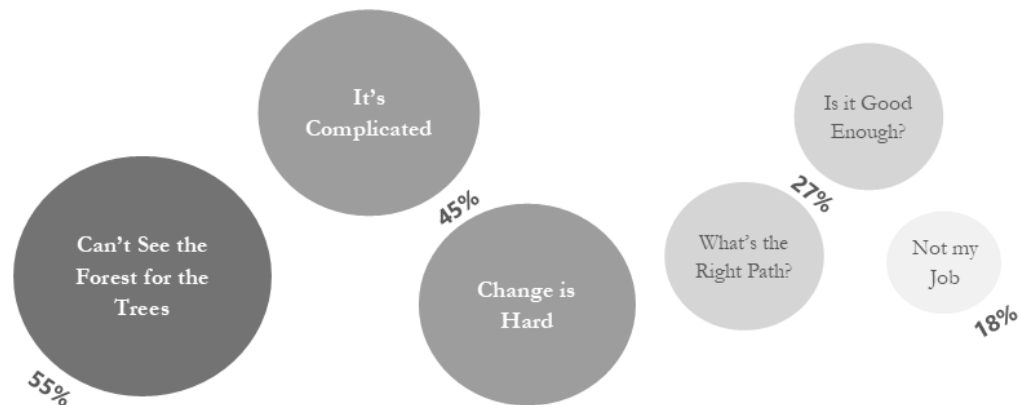


Figure 4-15. Percent of Interviews that Discussed Complication Motivation Barriers

Complication Motivation was the second most frequently mentioned subcategory of Internal Barriers, made up of barriers that relate to the difficulty identifying the correct path forward and the challenge that comes with having to prioritize multiple strategy types at once. The ‘grey area’ nature of stepping away from a recycling-first mindset was outlined as a large challenge. *Figure 4-15* provides an examination of all barriers mentioned in this subcategory, highlighting three as the most frequently mentioned during interviews: (1) *Can't See the Forest for the Trees*, (2) *It's Complicated*, and (3) *Change is Hard*.

Can't See the Forest for the Trees was the most commonly mentioned barrier, defined as the challenge of being *over* focused on recycling without being able to focus on broader solutions. This over-focus was introduced by 40% of Oregon and 67% of Washington interviewees. When discussing the push to recycle more plastics, an interviewee noted “I think people tend to forget the end game and what we’re trying to accomplish.” The reasoning behind this fixed focus, interviewees noted, came from a few things, two of which being habit and the length of time the message has been in place. “So much of this type of work for decades has been we’ve gotta fix recycling” commented one interviewee, emphasizing how deeply engrained this messaging and focus has become over time. This durability of time, as well as the emotional connections emphasized earlier, make for a sticky message, one that distracts from the big picture and goal of sustainable waste management systems.

Two other barriers were referenced frequently within this category, the fact that *It's Complicated*, a barrier closely linked to the *Too Complicated* External Barrier and that *Change is Hard*.

It's Complicated arose in 20% of Oregon interviews and 67% of Washington interviews, pointing to how the complication of finding the 'right' solution becomes so large the issue begins to feel inaccessible, reflecting similar challenges to the *Too Complicated* External Barrier. "It's just too much to even try and figure out or think through" an interviewee explained when discussing why industry professionals seemed to struggle with discussing more innovative changes "and it depends on what whether you care about greenhouse gas emissions, or water conservation, or waste going to landfill, and how you weigh all of those then gets tricky." There are no easy, cut and dry solutions, and the grey areas that exist as a result become difficult to navigate, leading many to choose to stick with the status quo. Particularly because change can be so difficult.

Change is Hard was introduced in 40% of Oregon interviews and 50% of Washington interviewees reflecting the challenges incumbent in the complication of finding good solutions. "None of [the alternatives] are going to be cheaper or easier than what we're currently doing, and that's a hard sell" explained a respondent. Loss aversion feeds into this challenge, as does the examination of sunk cost. People resist change and have a natural bias to what they are used to. "They're really stuck with...well this is how I've always done it and now they're telling me I have to do it differently" a different respondent summarized, "I think the resistance is a lack of imagination, lack of experience," barriers that naturally lead to a desire to keep things as they are.

4.3.3 Conditional Motivation

Conditional motivation, defined as conscious motivations that are either related to vested interests, such as maintaining one's job and reputation, or resignation to the current condition of things, is perhaps the easiest to identify, as these barriers are often related to tangible concerns.

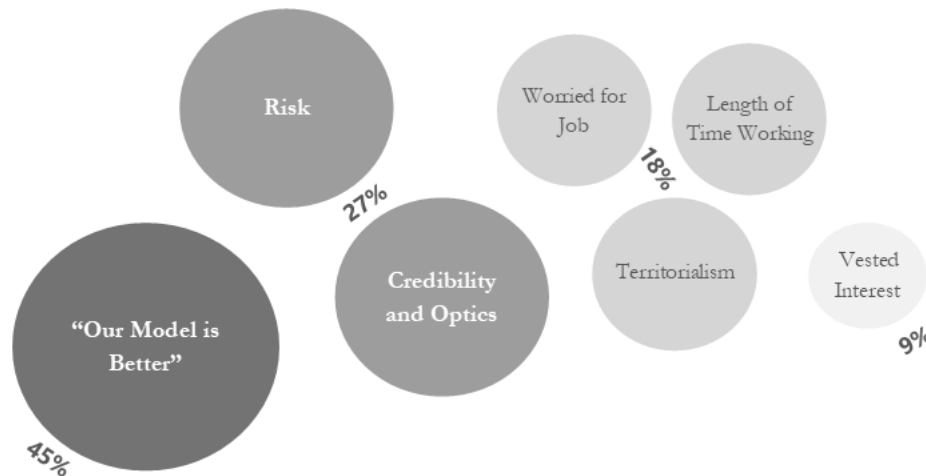


Figure 4-16. Percent of Interviews that Discussed Conditional Motivation Barriers

Conditional Motivation fell into two primary groups of barriers, a resignation to the way things are and a set of vested interests and concerns that leads to resistance to change. Often these motivations tie into fear, fear of losing one's job, one's reputation, one's political credibility, or one's authority. In some cases, it is beyond the individual, stretching those concerns to one's organization or government, as seen in the most commonly identified barrier. Figure 4-16 provides a full overview of the barriers identified within this subcategory, highlighting three

barriers as most frequently mentioned: (1) the regional “*Our Model is Better*”, (2) concerns regarding *Risk*, and (3) working to maintain *Credibility and Optics*.

“*Our Model is Better*” refers to regional loyalty to a specific type of solution or model appearing most commonly as a barrier in this subcategory with 60% of Oregon and 30% of Washington interviewees introducing the concept. As outlined in section 4.1.1, Seattle and Portland diverge sharply in what they view as the strategic way forward in relation to sustainable waste management. This, interviewees indicated, can lead to a regional loyalty to a specific way forward. “I feel like everyone thinks they’re doing the best thing” an interviewee stated, “that our model is better.” Speaking with interviewees, it was not uncommon for them to disparage the other state’s way of doing things. One interviewee summarized the challenge to it- “where you run into the problem is someone will want to get up and they’ll want to say ‘this is it!’ and the reality is yeah, that might be great for this segment of the waste stream, but holistically looking at everything, that might not work for everything.” This regional tie often restricts conversation, as well as the ability to holistically integrate different strategies to create more complicated solutions that are tailored to complex challenges.

The second most frequently mentioned barriers in this subcategory were *Risk*, referring to the risk incumbent in changing away from an entrenched system like recycling where it is unsuccessful and *Credibility and Optics*, which refers to a concern around the loss of credibility and the resulting public appearance should one change course.

Risk was mentioned more frequently by Oregon interviewees at 40% frequency, with Washington respondents only introducing the topic at 18% frequency. These risks may be many things- risking one’s job, friendships, professional relationships, reputation- going against the status quo has the potential to put all of these things in jeopardy, and with a system as thoroughly entrenched as recycling financially, emotionally, and beyond, going against that system can lead to significant losses. “You can find yourself in a kind of dangerous position” an interviewee stated, “to question the status quo.” The other risk incumbent in this is the risk of change-changing from an existing system to a new, unproven one carries with it risks of failure. That risk of failure ties into the other risks listed and can create a strong resistance to the desire to innovate.

Credibility and Optics was mentioned more frequently by Washington interviewees, highlighted by 50% of interviewees while none of the Oregon interviewees introduced it as a barrier. The message of recycling being good, being universally the right thing to do, being effective in every instance, has been firmly rooted in society, and loosening that message can come with the need to admit that, at least in some ways, that message was wrong. Changing educational programming means acknowledging the initial message was flawed. In Oregon this may be less of a challenge as SSM has already started to loosen that message somewhat, but the message behind Zero Waste can be easily misconstrued to one that defies recycling and easing the hold of that message without losing face and public trust, particularly with all of the cultural factors discussed earlier, comes with robust challenges.

4.4 Solutions

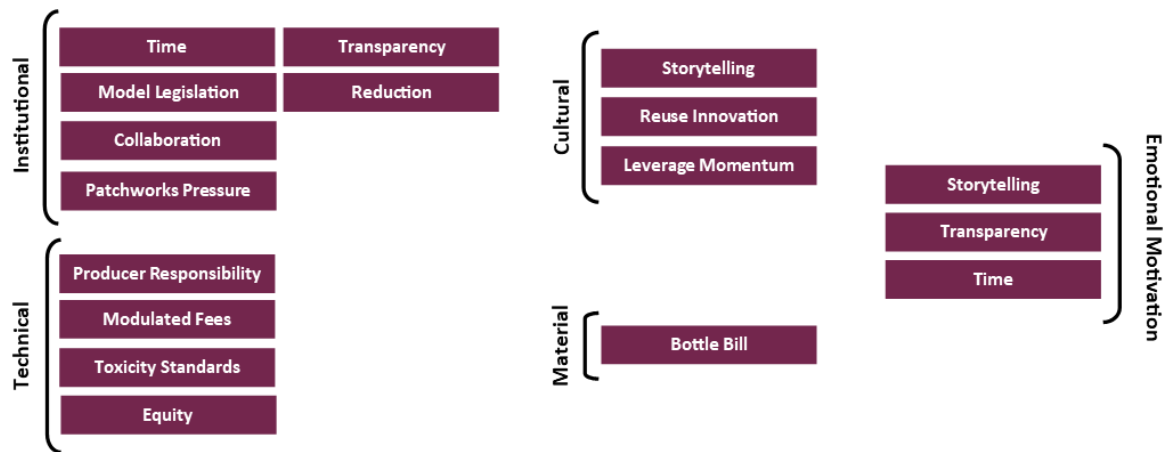


Figure 4-17. Identified Codes for Solutions Category

Figure 4-17 provides an overview of the solutions suggested by interviewees to the outlined plastic recycling problem. Codes are broken into the subcategory that would be impacted by these changes. Though *Modulated Fees*, *Toxicity Standards*, and *Producer Responsibility* would require some policy element to implement, they would *impact* production and technology, and as such apply to changes to the Technical realm. Additionally, a few solutions were identified to have the potential to influence internal barriers as well, *Storytelling*, *Transparency*, and *Time*- these were listed twice to highlight their dual areas of influence.

Solutions were by far the most contentious category, among the fourteen solutions coded, only four were introduced by two different interviewees, and of those four, only *one* was repeated more than twice. As the focus of this study is not to provide solutions, and as the establishment of concrete solutions would vary wildly depending on the region of focus, limited time will be given to their examination, however they have been included here as an opportunity for future examination and research.

Solutions that addressed Institutional and Technical barriers were most commonly cited as solution pathways, with particular focus placed on the Technical. Of the solutions, most agreed upon, with five interviewees discussing its necessity (2 from Oregon, 3 from Washington), was *Producer Responsibility*. “There needs to be accountability at the end of the hose” one interviewee summarized when highlighting the necessity of producer management. Another introduced the U.S. Plastics Pact as a potential avenue to increase producer responsibility, working with producers to guide them towards personal targets and commitments. Many also stated EPR legislation was key to implementing change.

Beyond *Producer Responsibility*, two interviewees each highlighted *Model Legislation*, *Reuse*, and storytelling as necessary priorities. Otherwise, accounts diverged, with some clear disagreements between interviewees on the correct path. Overall, potential solutions are a key area requiring more research. However, due to the nuance and interconnected complication introduced by this study, those changes cannot begin without the tools to understand the problem barriers locking the system into place, how they interact, and where to apply pressure to interrupt the chain.

4.5 Barrier Overlaps

One final key finding exists in where the outlined internal and external barriers *overlap*, indicating a particularly strong barrier to break as it acts as an external force against change as well as an internal resistance. These overlaps were found in five key barrier combinations:

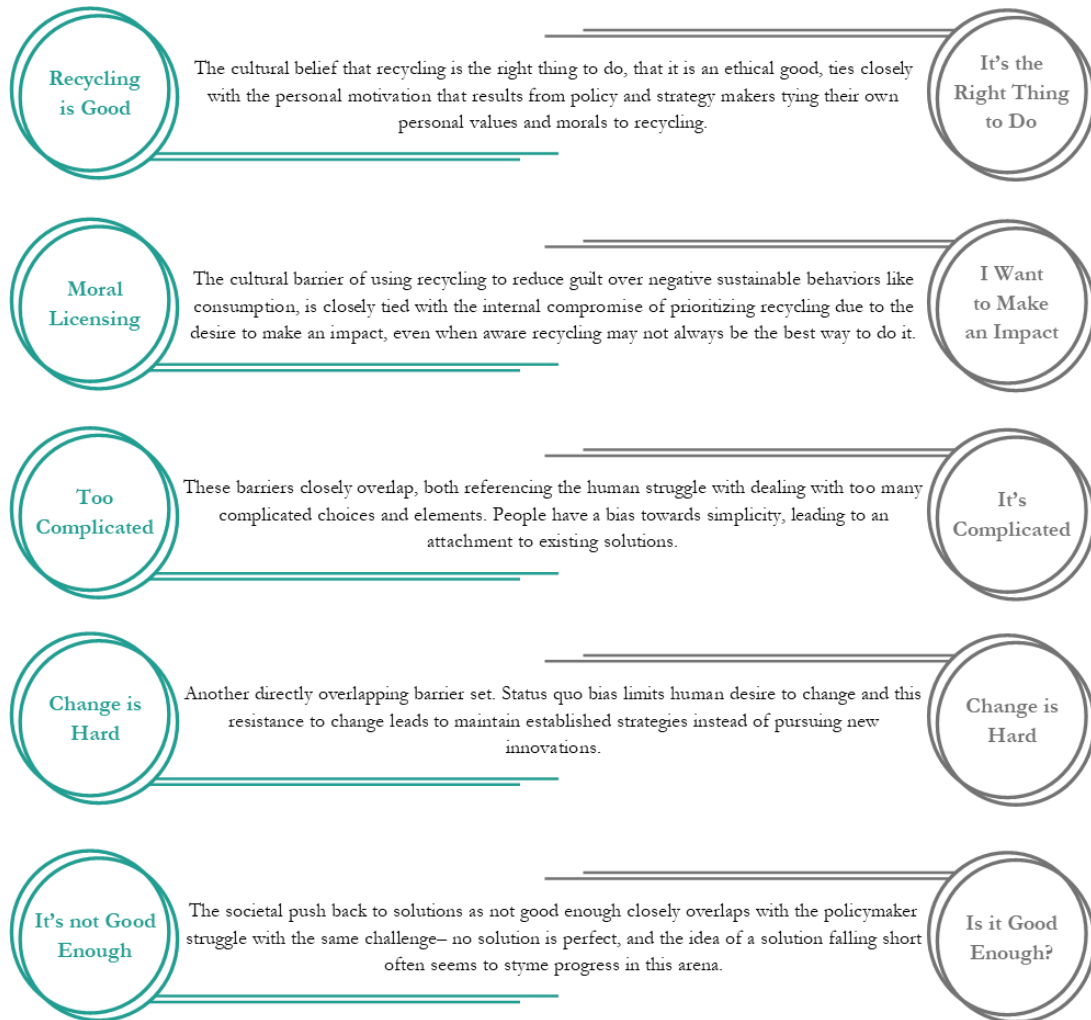


Figure 4-18. Internal and External Barrier Overlap

Many of the External Barriers facing overlap are Cultural ones, while many of the Internal Barriers are Emotional- tied up in the 'recycling mythos' that society has built around the waste management strategy. This stands to reason, as in many cases individuals are the ones who guide strategy and policy, and they are just as influenced by cultural and societal values as external stakeholders.

This can create a positive feedback loop, as when belief in recycling as a moral practice is instilled in an individual they are likely to engage in practices such as making policies promoting educational messaging and creating measurements and goals centered around that value. When that action is pursued, it amplifies the message that recycling is the right thing to do, further instilling the value in culture and communities, influencing future policy and strategy makers to mirror those ideals. As such, these barriers that overlap can create some of the stickiest webs, and if only internal or external is focused on, it is very likely the challenge will not be adequately addressed as the amplification mechanism will still be in place.

5 Discussion

5.1 Relevance and Application of Results

The first impulse when faced with as many codes and barriers as have been established in this study may be to seek simplicity and consolidation. Indeed, in many instances with framework development the goal is to provide greater simplicity, to narrow focus, which the provision of 95 codes of course does not do. However, in the case of plastic recycling, perhaps part of the failing has come from the issue being overly simplified in the past- the nearly fifty-year focus on, as many interviewees referenced, the message of “recycle, recycle, recycle” exemplifies this challenge. Though simplicity can help drive action and provide direction, the multifaceted, interwoven nature of these issues requires instead an understanding of complexity.

In many cases, oversimplification in problem solving for this issue can lead to a perpetuation of problems. For example focusing on “public demand for more recycling” as a single issue does not adequately address the policies, messaging, producer pressures, and more that amplify that *Public Pressure*. If only public demand is addressed, the problem has not been adequately neutralized without understanding all of the feedback loops that build that demand. As such, a complex understanding of these knots and cycles is required. Only by seeing the full picture can the appropriate leverage point be identified and leaned into.

However, in order to find solutions, some context and consolidation must be found. In order to achieve this while still allowing room for the nuance of these overlapping, intertwining barriers, the research seems to lend itself best to a type of mapping process using feedback loops as a way to contextualize barriers against one another and develop tracking and measurement standards.

5.1.1 Feedback Loops:

One of the key themes that was nearly constant across all interviews was that of the sheer *complexity* of untangling this system, referred to as a “Gordian knot” by one, with every element connected to another- every proposed solution followed by a different interviewee stating that solution would result in abject failure. Oregon’s *What it Is* was not strong enough, while Washington’s *What it Could Be* was missing the big picture.

The scope of this research is not wide enough to address how to solve the knot of plastic recycling, a solution that is likely widely variable and requires concentrated effort dependent on regional makeup. However, this beginning understanding of the chain of barriers that lock in the plastic recycling system in these two regions of focus has made clear the cyclical nature of many of these problems. As such these barriers must be understood in relation to one another to form an accurate understanding of the system and how to change it

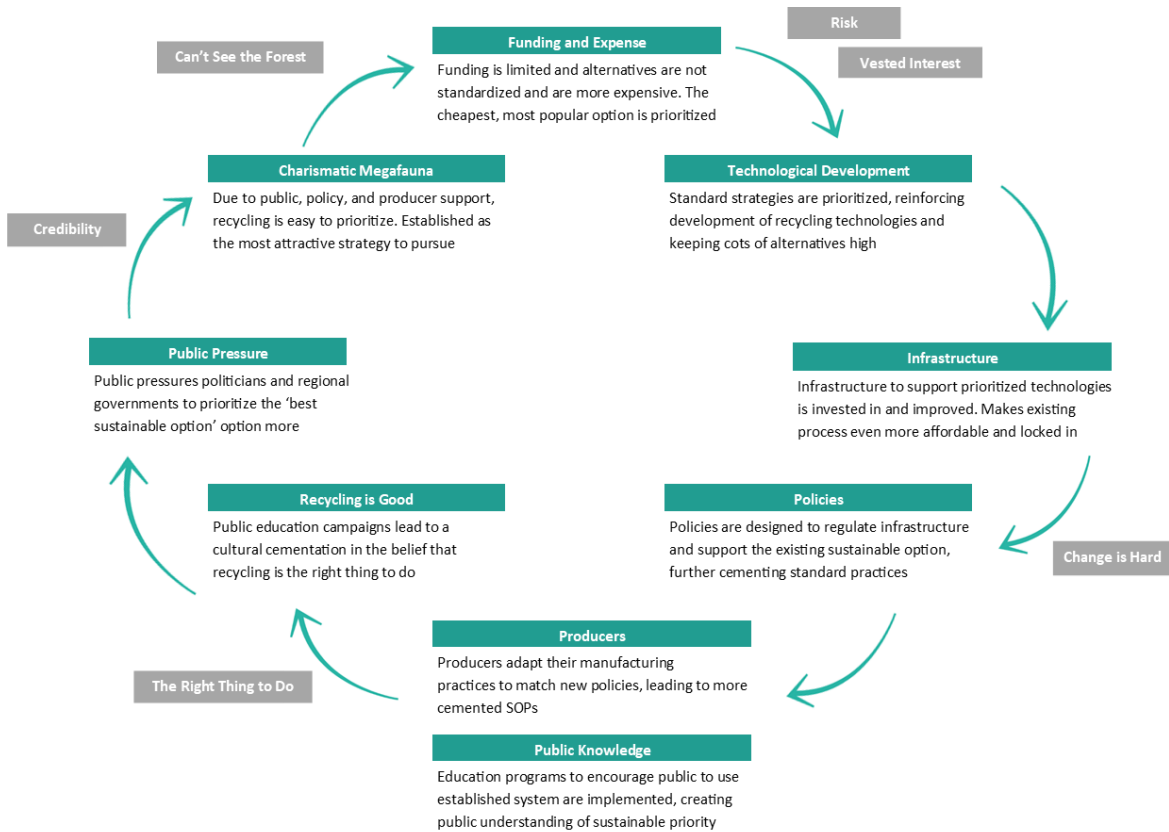


Figure 5-1. Cycle Application Example 1 – Funding and Expense

Figure 5-1 serves as an example of how barriers can be utilized after the process of their identification is completed. *Funding and Expense* was utilized as the barrier to map around due to its status as the most mentioned barrier in the interview process. In the instance of this examination, the focus is on the plastic recycling system, with a particular focus on recycling infrastructure such as sorting technology. Measured up against a more innovative technology like the hotly debated chemical recycling, this cycle can be used to understand what is holding the recycling process in place.

It is important to note that as this cycle has been running for several years, every piece of the cycle now has its own driving power and cementation. Infrastructure is not just being developed at present, but also *exists* and has been built up over decades, creating a lock-in of that amplification element. This is also the case with policies- regulations and standardizations of the recycling process have been implemented over time, making for an established factor that would need to be considered seriously to break that piece of the amplification chain.

It is important to note that the links outlined in *Figure 5-1* are not the only links possible and this is not the only cycle that could be created around the baseline of *Funding and Expense*, but it can act as an example of a way to consider and engage with the complex set of barriers identified in the findings process.

Another example of this process is outlined in *Figure 5-2*, this time utilizing one of the overlapping barriers- *Recycling is Good* as a baseline external barrier with a secondary, smaller loop considering “*The Right Thing to Do*”, the internal barrier that matches. This figure considers how the internal cycle and the external cycle may influence one another, creating an even more solidified amplification cycle.

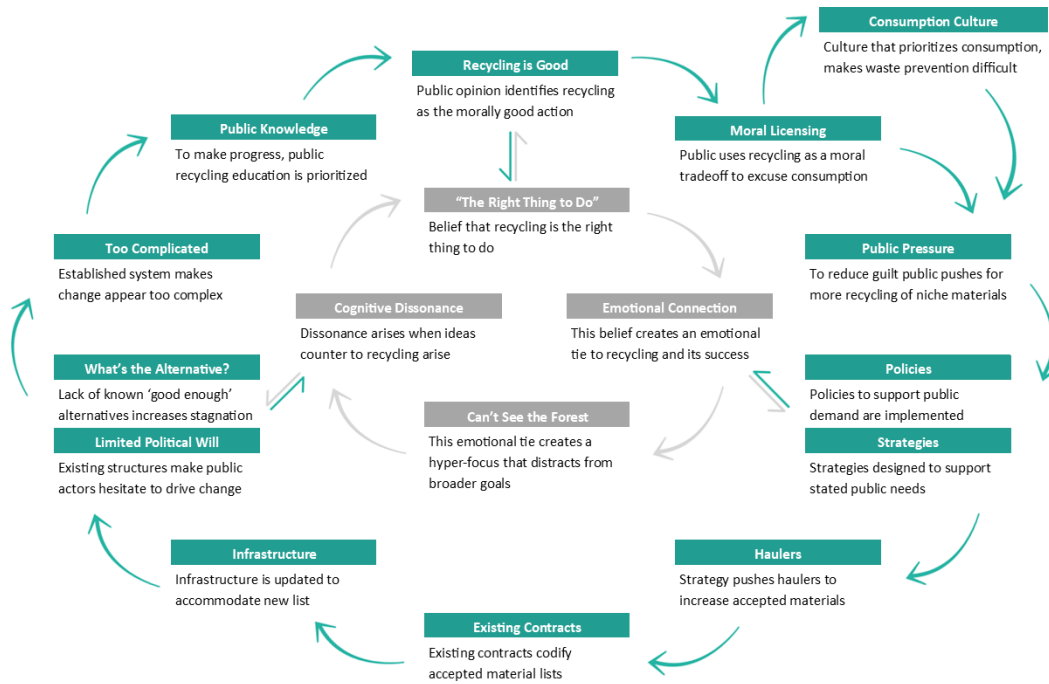


Figure 5-2. Cycle Application Example 2 – Recycling is Good and « The right Thing to Do »

This modeling structure can help act as a way to understand the interdependent variables of a problem or of a realm strategists or policymakers are working to design a fix for. If planning an intervention in regard to public knowledge, for example, it is valuable to understand what may feed into that knowledge base, and how initiatives may be influenced or weakened by those amplifying factors. As such, this modeling strategy can assist with holistic understanding of problems that initially appear too complex to untangle. Figure 5-3 provides further example of how this intertangling and influencing can be examined through the mapping process using the external *Too Complicated* barrier and the internal *It's Complicated* barrier as a baseline.

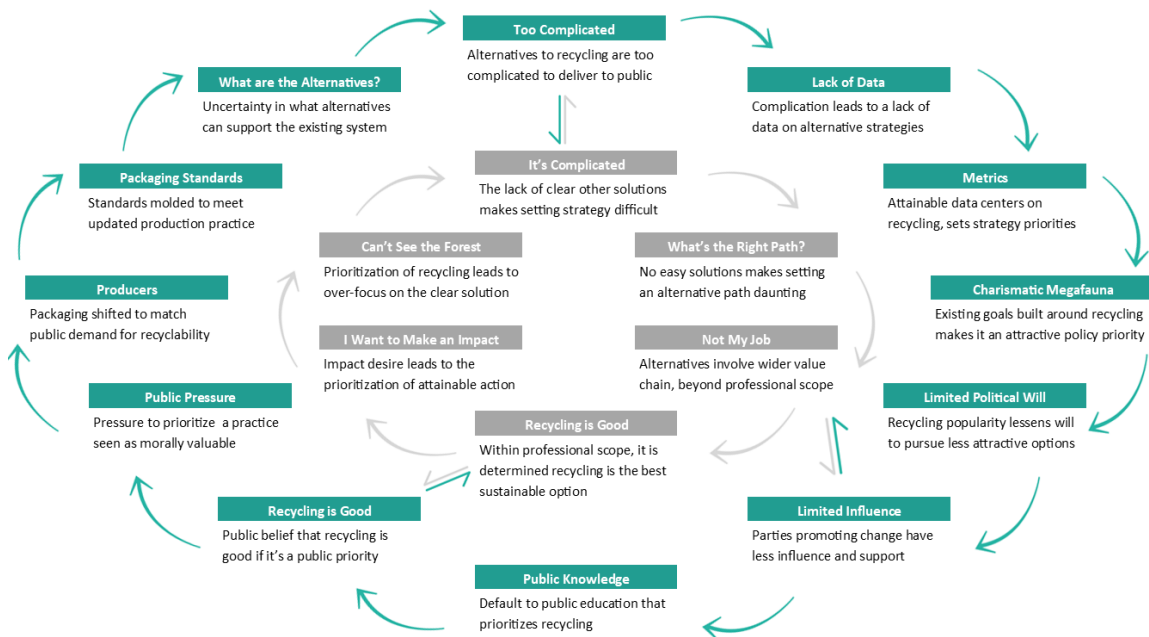


Figure 5-3. Cycle Application Example 3 – Too Complicated and It's Complicated

Understanding internal motivations also may assist policy and strategy makers with facing what may hold them back or restrict their or others' motivation to address specific stages of the cycles. This understanding can help with self-critical development and assist in awareness of internal hesitations that may not initially be visible. As such, this can be used as a communication tool, as a way to identify limitations and difficulties that are part of human nature and completely understandable but may be holding departments or regions back from fully addressing the problem at hand. Mapping these factors all together in the analysis structure outlined in *Figures 5-1, 5-2, and 5-3* can help make these intangible elements more accessible.

5.2 Expanded Opportunities for Application

5.2.1 A System in Upheaval

Both Washington and Oregon are in flux at present, working actively to solve problems with the system identified and beyond. This state of upheaval is clearly exemplified in separate present and upcoming transformative legislation that would significantly influence plastic waste management that both states are in the process of examining. For Oregon, it is Senate Bill 582, the Plastic Pollution and Recycling Modernization Act, (2021), and for Washington it is Senate Bill 5022, concerning the management of certain materials to support recycling and waste and litter reduction (2021). In interviews, each bill was brought up frequently as a sign of the direction the state was heading, and progress towards long-term waste management goals.

Oregon's SB-582 was, according to an interviewee, designed to fix problems related to the management of plastic waste and recycling to allow the state to focus on broader value chain-based issues in the future. Its key initiatives focus on creating a producer responsibility system, referred to in the bill as a 'shared responsibility' model, for packaging, printing and writing paper, and food service ware. It additionally sets standards for the improvement of multifamily recycling programs and sets new standards around recyclable processing facility regulation (Plastic Pollution and Recycling Modernization Act, 2021). "That is probably the biggest piece of legislation that I've worked on in the industry across partners in my history" an interviewee stated, highlighting the transformative nature of the bill.

Washington's SB-5022, currently in process of being signed into law, is similarly transformative but focuses more on promoting recycled content use and reducing plastic generation directly. As such, its key initiatives are designed to increase requirements and reporting for post-consumer recycled content in plastic beverage containers, plastic trash bags, and plastic containers for household cleaning and personal care products; prohibit specific types of polystyrene; and require single use food service products such as straws, utensils, and condiment packages only be available upon request. "The initial 5022," and interviewee shared "was about making everything compostable or recyclable by 2028 or 2030" but the bill evolved to its current iteration by the time it reached the legislative session.

Both of these bills work to address one of the key External Barriers identified- *Producer Responsibility*. By putting expectations on the producers to improve the products they create or become responsible for the end-of-life management of their materials, the potential for more sustainable plastics creation and management is established. These bills would also help target the *Limited Influence* barrier, as a good deal of the lack of influence that was highlighted by interviewees tied back to not being able to sufficiently alter the production behavior of global producers. Both of these bills put pressure on producers to alter their processes to better support the management of plastic waste, reaching into the realm of producer influence.

Producer influence is also being engaged with in Seattle with the U.S. Plastics Pact, a public-private collaboration between the stakeholders responsible for plastics intended “to rethink the way we design, use, and reuse plastics, to create a path forward to realize a circular economy for plastic in the United States” (U.S. Plastics Pact, 2021). This pact is particularly focused on producers, with pledges centered on four main goals: (1) Elimination of identified problematic or unnecessary plastics; (2) Increasing reusability, recyclability, and compostability; (3) Improving diversion of plastics; and (4) Increasing recycled content use (U.S. Plastics Pact, 2021). By engaging in this pact, Seattle may be able to address barriers such as *Limited Influence* by improving collaborative reach, *Conflicting Interests* by creating centralized targets; and *Producer Responsibility* by interfacing directly with large producers to implement goals.

Several interviewees from both regions mentioned also focusing on improving how they measure success, and how altering *Metrics* is an active goal for them. “Previous to our current plan our sole measure of success was our recycling rate and increasing our recycling rate” an interviewee explained when discussing recent measurement priority changes “we weren’t focused on contamination [or] waste reduction.” With updated strategies and plans, such as the Metro’s 2030 Vision and Seattle’s upcoming Solid Waste Management Plan update, work is being done to adjust those metrics to better prioritize changing targets such as prevention, contamination, and reuse, changing the priorities and measures of success for regional stakeholders.

In part this push towards change stems from China Sword, interviewees indicated when discussing what allowed room for recent changes. Many indicated that it was not a lack of interest in making these changes in the past, but as China Sword has sparked public interest and brought up increasing questions of responsible, equitable end markets, available political capital to engage with these issues has increased. This is both because of increasing public attention and concern, from public awareness that plastics are not always recycled the way society thinks they might be (Sullivan, 2020) to an understanding of what happens to materials when they are uncritically shipped overseas (Plastics, 2021); as well as due to an increasing understanding on the side of policy and strategy makers of what end markets may truly look like. “We can’t continue having our plastics ending up in places where we don’t know” an interviewee stated in reference to the issue “that scares a lot of us, knowing that it might be disposed of in ways that would be horrible to find out.”

This increasing knowledge both internally and externally has led to drive for change, and as international markets shift, making lower grade plastics harder to sell and reducing contamination more urgent, pressure to improve the system has risen. This disruption of the status quo leaves an opening for further improvement, something this research and future research can help support.

5.2.2 Application of Results in Different Regions and Contexts

As such, these codes and this model of feedback loop mapping aim to act as a jumping off point for others looking to engage with the resilient policies that only partially work in the solid waste sphere, be it plastic recycling or other, but are treated as a total solution for the sustainable solid waste issue. Independent regional or problem-specific research would be required in order to understand system-specific qualities and barriers as this research is not designed to be fully generalizable beyond the regions of analysis. However, with appropriate context others may be able to build out their own barrier maps to understand what feeds these knots, and how to discuss their untangling.

Further research into how universal specific barriers are would be a valuable way to expand this body of knowledge however- understanding how regional factors may influence internal and external motivations and limitations would provide valuable data to help understand what may be holding back dynamic policy and strategy change in the broader solid waste realm. Similarly, developing an understanding of if there are any barriers that are reoccurring no matter the region or context would be incredibly valuable element of data to expand the knowledge around this issue.

Finally, a key finding from this research was the five sets of barriers that overlapped across the internal and external spheres, and obtaining a deeper understanding on these key factors, how they manifest differently in internal and external contexts, and how to better break both the internal and external elements of their manifestation appears to be a valuable opportunity for further study and understanding.

5.3 Reflection on Theories

This analysis was primarily built around two theories: the sunk cost bias and the lock-in effect. It was, however, uncertain if these theories would be proven applicable to the data once collected, acting as a retroductive approach to data analysis. As such, it becomes necessary to reflect on the nature of these initially examined theories to understand their applicability and relevance to the final results.

5.3.1 Sunk Cost

In examining sunk cost, the results deviated quite significantly from the theory as the primary frame for analysis of Internal Barriers. While factors of sunk cost can be found within each of the established categories, sunk cost was found to be of limited broad relevance as a contextualization tool once Internal Barriers were fully outlined. Its elements, particularly those related to loss aversion, risk aversion, and cognitive dissonance were certainly a piece of these barriers, but overall it was found to be a small part of the broader puzzle. In order to understand its relevance, *Figure 5-4* provides an outline of codes that integrate into sunk cost concepts.

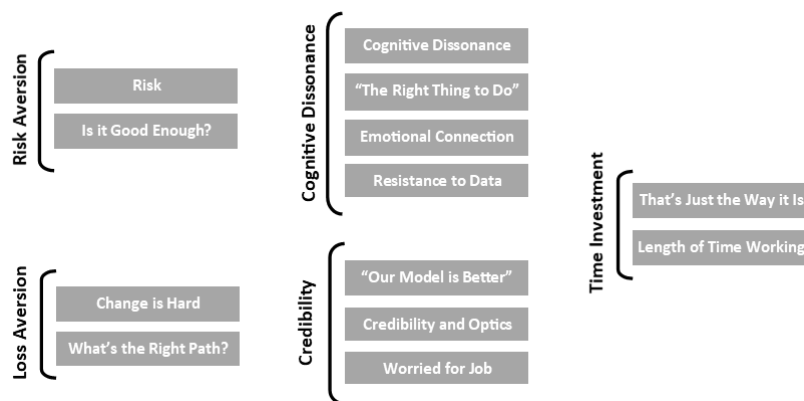


Figure 5-4. Overview of Sunk Cost Codes Outlined in Thesis Research

Sunk cost bias provided a necessary lens into a broader set of complications- behaving as a baseline around which research could be developed, a guide for the framing of interview questions, and a way to begin to approach barriers that ended up being much broader in scope. Not only this, but in many ways the tenants of sunk cost can further cement the effects of lock-in, particularly in relation to time. "Moving to another system then you're disregarding 50 years' worth of effort" an interviewee explained, "and what if the next system isn't any better? And what are the unintended consequences of that new system as well?" Concerns around change

and the connection to a system that has been built over years, these aspects combine to create prevalent biases.

Though sunk cost was highly useful as a contextualization tool, it is important to recognize it is not the *only* internal motivational factor, and that simplifying personal motivation to one independent theory may not do the complexity and depth of this challenge justice. Indeed, of the 20 internal barriers identified, only 13 could be related back to sunk cost principles, and of those some more closely related to biases such as loss aversion, risk aversion, and cognitive dissonance than relating directly to sunk cost, i.e. resisting change due to the valuation of past investments. As such, while sunk cost *certainly* informed the design and structure of research, and can help contextualize some motivations within Internal Barriers, it is hardly the primary or only bias or point of resistance. Nuance is instead required to catch the full range of barriers present in this system, and as such an inter-disciplinary and multi-theory approach is vital.

5.3.2 Lock-In:

As a direct counterpoint, lock-in has proven exceptionally useful as a frame for the External Barriers and almost universally acted as a competent frame for contextualizing their relevance. The four lock-in categories were not perfect- an Other Barriers subcategory was necessary to cover elements that did not quite fit one of the four groupings, but overall they acted as a strong way to provide focus and classification for a complex data set.

While Internal Barriers could have been fit to a certain degree within lock-in categories, and indeed in the case of Cultural lock-in, linked closely to external counterparts, the strength of that categorization was much weaker and was subsequently eliminated in order to more honestly evaluate how Internal Barriers grouped together. *Figure 5-5* provides an overview of how this application could be done.

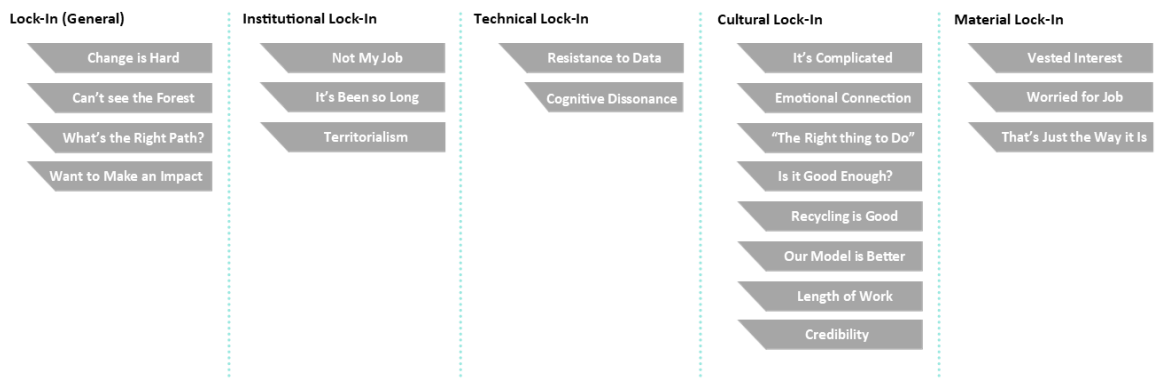


Figure 5-5. Application of Internal Barriers to Lock-In Groups

However, for External Barriers lock-in proved an extremely useful categorization tool, and similarly helped provide an understanding of what areas of focus are potentially most relevant to examine. For instance, Institutional and Technical lock-in categories were by far the most frequently and were also the most commonly mentioned as arenas where solutions could be applied. As such, they provide a key opportunity to understand where intervention priority lies. Yet Cultural barriers were the ones that most commonly overlapped with Internal Barriers and can be understood as particularly sticky limitations that hold value for understanding. Material, as a counterpoint, was barely mentioned with only two barriers identified for the lock-in type, providing an insight on what may be prioritized and relevant to the group interviewed.

Overall, lock-in provided valuable concatenation frames and interesting opportunities for understanding which societal realms are the highest points of focus while still allowing room for complexity. In many ways, the theory helped simplify in a way that did not eliminate nuance but allowed for comprehension.

5.4 Reflections and Limitations

Limitations to this study were most significantly consolidated in the methodological structuring of theories and interviews as well as in the data collection process.

5.4.1 Methodological Limitations

Key methodological limitations identified largely centered around the theories selected to analyze results and interview structuring.

In regard to theory, the theory selected, sunk cost, was found to be too limited and focused to adequately cover end results, which seemed to reach between several different potential behavioral and psychological theories. As such, a broader theoretical model may have been a better choice, such as utilizing bounded rationality as a holistic concept rather than just one theory or bias within the broader category. This would have better encapsulated multiple motivations for behavior and could potentially provide a stronger subcategorization system. While the three subcategories established served the data well, further research on if a model exists to better encapsulate the range of Internal Barriers identified may have provided stronger foundation for examination.

Interview planning and structuring had two primary limitations: interviewee selection and questions structure. When considering interviewee selection, a snowball method of selection was utilized, leading to a higher potential that perspectives would be similar as the individuals spoken to were selected either because they were known by the researcher or referred by the first round of interviewees. A more impartial model of data collection would have been to obtain a list of all professionals in the region and select interviewees at random, but due to the nature of establishing professional contacts who would be willing and able to make the time to discuss the research at hand, the snowball model was best suited to the timeline and research at present.

As interviews were a semi-formal structure that prioritized perspectives, questions asked during interviews were not always the same, instead adjusted to match the flow of conversation and relevance to the individual's context. Interviews followed a fairly similar structure to the one outlined in *Appendix 3*, but it did not act as a universal guide, providing instead an overview and template that was restructured to match the needs of the conversation. As such, data received from interviewees did not always follow a fixed formula, which created a variation of results.

5.4.2 Data Limitations and Assumptions

This study was designed as a narrative analysis, utilizing a range of perspectives to gain a deeper understanding of what the individuals in the field identified as their largest challenges. As such, a great deal of interpretation was required, creating the possibility of more limited data accuracy. This limitation manifested in particular in relation to interview coding- interview questions were designed as open and broad in order to prompt an extensive variety of potential responses, and as such utilizing key words to identify how to code different statements was not possible. Instead, interpretive analysis was required, and as such it is possible that some statements would be understood differently by another researcher. In order to increase transparency around these decisions, *Appendix 5* has been provided to outline the definition used to pinpoint the manifestation of different barriers, and time was taken to address personal biases to ensure as impartial of an analysis as possible. However, as narrative interpretation is a key part of this

research it is impossible to completely remove researcher interpretation and perspective from the analysis provided.

Furthermore, as interviews are personal perspectives, there is some bias implicit in data and results based on how professionals in the field view the issues. This is particularly true when it comes to internal biases and barriers, as self-introspection can often be difficult, and one's own biases can be difficult to detect. This limitation was addressed in a couple of ways: (1) Asking questions in a way that investigated what might be holding *others* back to limit the pressure on the interviewee and (2) Using percentage mentioned for barriers as a way to highlight when data points were corroborated and replicated. By using these two techniques, more accurate results were obtained, however it is important to recognize that in speaking with a different demographic, results may vary, particularly when considering the Internal Barrier category.

Finally, there is the possibility that some challenges may be considered 'common knowledge' and did not enter into the conversations as frequently for this reason. For example, certain solutions such as increasing repair and reuse practices, were rarely mentioned during interview discussions, yet every strategy document mentions these strategies. It is very possible these were not mentioned because they are not considered relevant 'big picture' solutions, but it is also possible that because they are considered common knowledge there is a blind spot to their discussion. Further research would be needed to determine this, but it is worth being aware of as a potential limiter to presented results.

One other limitation element in the data collection stage comes from regional similarities and differences: while initial research indicated Seattle and Portland were very similar as comparative options, interviews revealed far more differences than initially anticipated. Particularly key here was how strongly each region aligned with its strategic framework (Zero Waste and SMM) and how commonly regional actors disagreed with the other's strategy of choice. Another key difference that was revealed came from which level of government was responsible for strategy and driving change- it was revealed in the interview process that for Portland, much of the innovation and strategy was driven from the state level, while for Seattle it was much more driven from the city level. These differences were monitored very closely to ensure they did not lead to drastically differing regional results, and in order to track potential variation, an analysis of regional frequency mentioned was added. This acted as a secondary verification tool to ensure comparisons were accurate and considered.

6 Conclusion

When it comes to plastic management, recycling is a necessary, valuable tool, and it should not be understated as such. However, recycling is just one cog in a greater machine that is needed to serve broader sustainability goals like reducing resource consumption, toxics generation, and greenhouse gas emissions. It is when recycling is treated as a universal cure that progress is restricted, creating a system that prioritizes a strategy that is not nearly enough to fix the broader problems it is designed to support. Yet recycling is *easy*, it is well loved, and it is cemented firmly in culture, institutions, technical structures, and physical systems. With so many elements locking it into place, it is expected that it is over-utilized, and hard to approach leaving behind in instances where it is not the best fix. Both for society as a whole and for the people responsible for creating the strategies and policies that guide solid waste management systems.

In order to address this challenge, this study built a framework and expanded understanding of what barriers exist to restrict policy and strategy makers' ability to innovate beyond recycling when necessary in relation to plastics management, as many factors appeared to be restricting conversations about and motion towards moving away from recycling-first solutions. In order to open up the opportunity for these conversations, two research questions were formulated and addressed, with answers built to support this goal.

RQ1: What are the interrelations between the sunk cost fallacy and lock-in theory and why do they influence decision making in relation to plastic recycling policy and strategic development?

Sunk cost was found to be most significantly interrelated with the Culture subcategory of lock-in, with strong relation between cultural factors and Internal Barriers related particularly to loss aversion and cognitive dissonance. However, most prominently sunk cost concepts acted as a complement to lock-in elements, providing context that supported internal decision making that led to a lock-in that was exemplified in the Internal Barriers category. As such, though sunk cost acted as a valuable initial framing device, it ended up having limited bearing on the final results that were obtained through the interview and subsequent organization process. Indeed, other sunk cost factors that related to risk aversion and investment focus (such as *That's Just the Way it Is* and *Length of Time Working*) were not directly related to a lock-in subcategory at all, but instead more closely related with regional development and personal, Conditional Motivation. Two other key Internal Barrier subcategories were identified based on the nature of the problems highlighted, Emotional Motivation and Complication Motivation, both of which held some barriers that related back to sunk cost but served to understand the groupings of barriers from a different angle that fit better in this context.

However, lock-in held a strong bearing on policy and strategy decision making in relation to External Barriers. Almost all identified External Barriers fit comfortably in one of the four subcategories of lock-in, Institutional, Technical, Cultural, and Material. All of these subcategories were found to have strong bearing on policy and strategy decision making according to interviewees and strategy documents, with Institutional and Technical barriers being highlighted as the most relevant. Cultural barriers, meanwhile, were identified as among the trickiest, as they overlapped most significantly with Internal Barriers, making for particularly difficult barriers to break. While Material barriers were much less frequently discussed, the primary barrier in the subcategory, *Infrastructure*, was found to be a key challenge according to interviewees, standing as a valid concern in relation to the broader challenge of policy and strategy change development.

Finally, four barriers stood out that were not easily fit into a lock-in subcategory, fitting under the groupings of *Equity* and *Complication*. While these factors were independent of the lock-in setup, they were still relevant discussion points, and are needed to be considered to fully obtain

a picture of the issue. This finding supports the retroductive nature of this research- in examining and establishing barriers an openness is required to including all relevant barriers, even when they do not naturally fit into a pre-established framework categorization.

RQ2: How do internal and external barriers restrict the development of innovative waste management strategies away from plastic recycling systems?

The answer to this question was found to be complicated and expansive, with 95 different codes established, 52 of these being an identified barrier type. Though the impulse would naturally be to reduce the number of identified codes, in this specific instance the complexity seemed to serve the challenge- understanding instead was sought through the creation of a list of most commonly mentioned barriers that may be places to start when considering solutions. As such, barriers were broken out into two primary categories: External Barriers and Internal Barriers, and then broken out into several different subcategories to match the framework established as a grouping method. Then the top two to three barriers identified per subcategory were highlighted and analyzed more deeply to help provide a more nuanced picture of what holds back further development.

Similarly, barriers that overlapped between the two realms of internal and external were highlighted and examined to provide more comprehensive understanding of barriers that may need to be broken both in society and in the people designing policy and strategy, a particularly challenging task to undertake.

With the most noteworthy barriers identified, a way to codify the way they overlap, amplify, and link to one another was established, to show how the interconnections further restrict development towards innovation. This mapping was designed to engage with barriers in a more considered way, and to start discussions around where leverage may need to be applied to foster change.

This work did not strive to provide solutions as solutions were found to be the most controversial element of the research, and further research would be vital to understand better where best strategies for solutions may exist. The answering of this research question instead provided tools and a framework for discussion to engage more holistically with the plastic recycling problem with the goal of helping discussions towards regionally appropriate solutions to be undertaken by those working in the field.

6.1 Recommendations for Practitioners

It is easy and understandable to become stuck in strategies and systems that only partially work and then feel locked into the path due to a seemingly impossibly tangled web of factors. “We’ve worked our way down one of these paths” an interviewee summarized neatly, “where it feels like you no longer can choose from all the options...it’s hard to give up that we’ve been on the wrong system.” In some ways admitting a system does not work universally can seem like a rejection of the system as a whole- a challenge that arose in the *Recycling is Good* discussion. Yet understanding where existing solutions are not enough, where change is needed and innovation is required, is vital to reach the larger goals of sustainability.

Steps are already being taken to start making transformative changes that will help re-structure the plastic management system in a way that better addresses broader sustainability goals: producer responsibility legislation, changing measurement systems to prioritize generation, reframing strategy to center around the full value chain rather than just end-of-life, all of these are strong steps that are being taken regionally to create a more integrative waste management system. The barrier identification process and mapping outline developed in this study serves

to help provide tools to begin further conversation in this direction and give contextualization instruments to help navigate the knots that make up policy and strategy change barriers in relation to plastic recycling.

Waste management structures are often a web of interested stakeholders, established infrastructures, regulations, and technologies, with significant economic interests tied up in their functioning. As such, addressing problems within the system holds similar characteristics with wading through a swamp, trying to find a way to make sense in a web of complications that often feel far out of scope for those engaging with them. But to make the change needed, we must become comfortable in the mire, become at peace with the webs and knots that we work within. This research acts to help provide a map to that mire, to support the conversations and development needed to reach the larger goals of sustainability that this industry strives to achieve.

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Appendix 1: Policy Brief

The following pages are dedicated to a policy brief designed to be provided to policy and strategy makers in the regions the study.

The focus of this document is on the practical, non-theoretical elements of the research, and as such sunk cost is not mentioned and lock-in is only mentioned to a limited degree for ease of access and applicability to the intended audience.

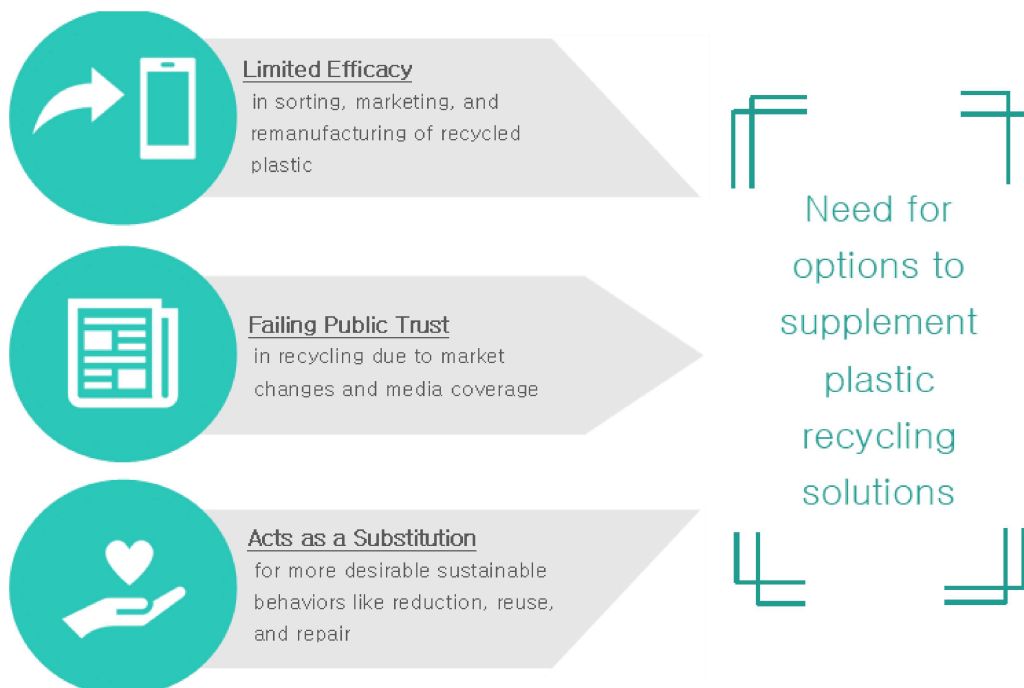
The Tangled Web We Weave

Barriers to Change in Regional Plastic Recycling Strategy Examining Seattle, WA and Portland, OR

- ◇ Research took place over the period of January 2021 – May 2021 in the form of evaluation of academic literature, 11 professional interviews (6 in WA, 5 in OR), and regional strategy document evaluation
- ◇ The study centers on the Pacific Northwest area of the United States. While each region has a different strategy framework (Seattle with Zero Waste and Portland with Sustainable Materials Management), barriers identified were commonly shared between the two regions, resulting in broader relevance of results.

Not Quite Enough – The Limitations to Plastic Recycling

Plastic recycling holds value as a **tool** in the integrated waste management strategic framework, but **lacks the sustainable benefits to act as a cure** to the broader problems of resource consumption, greenhouse gas emissions, and toxics generation present in the waste management system. With plastic material, the largest manifestations of these limitations are:



These gaps emphasize the necessity for the movement away from a recycling–first strategic structure, highlighting the need for the prioritization of alternative development with plastic recycling as a supplement to support higher order strategies such as prevention and reuse. However, change towards these more sustainable solutions when necessary is slow, and often difficult to achieve. This study therefore seeks to **identify key barriers** to making needed change and **support planning development** towards more sustainable waste management systems.

Barriers to Change: External Barriers

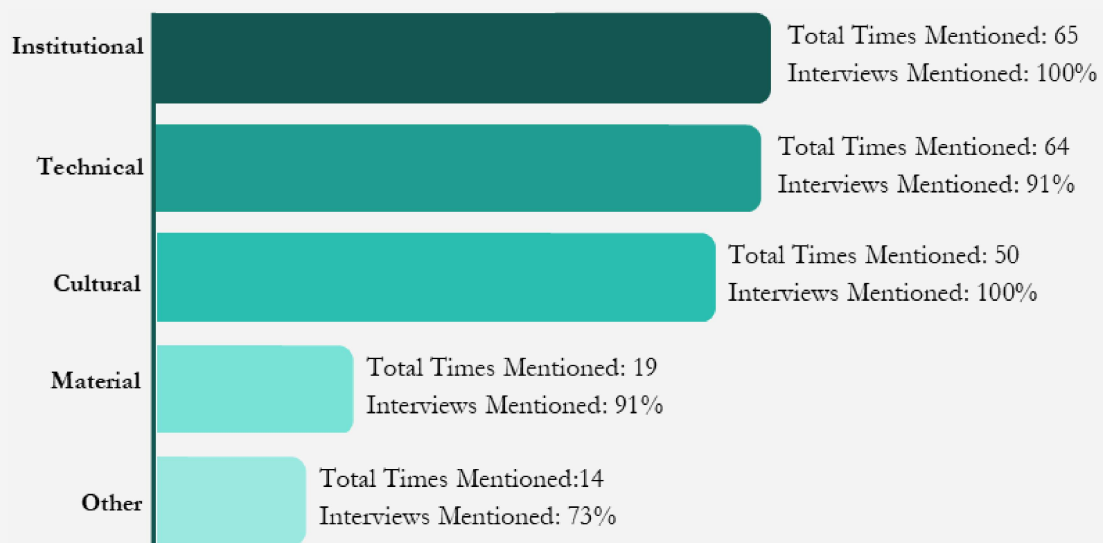
External Barrier Categories: Lock-In Effect

Lock-In is the system of networks that locks actors into webs of policies, technologies, physical infrastructures, and cultural norms, restricting innovation potential¹

- **Institutional:** Legal and political domains (policies, strategies, regulations)
- **Technical:** Technological and economic domains (design, markets, funding, available knowledge)
- **Cultural:** Cognitive and cultural societal aspects (expectations, norms, preferences)
- **Material:** Infrastructural and physical structures (buildings, facilities, equipment)
- **Other:** Additional elements of note (equity and globalism)

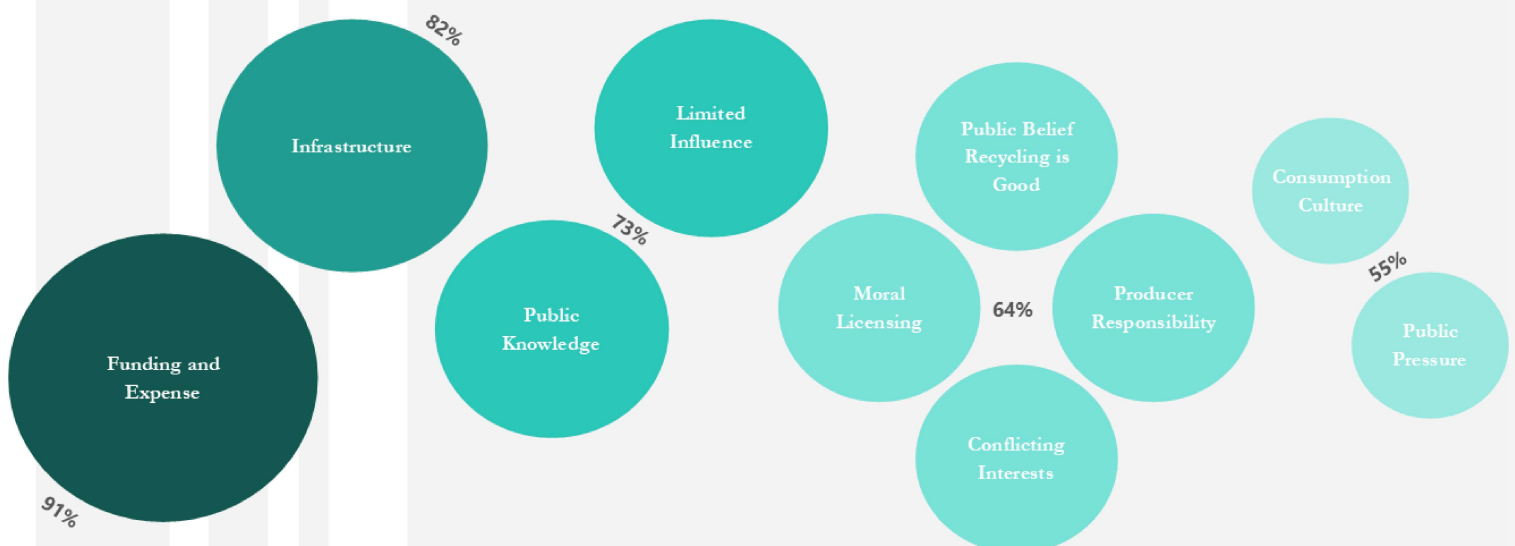
Category Priority:

In an overview of how frequently each category was discussed in interviews, **institutional and technical** were the most prominent domains introduced



Most Highlighted Barriers:

In the interview process, **10 barriers** were mentioned the most frequently by interviewees. Percent frequency barriers were mentioned is outlined below.



¹Corvellec, H., Campos, M., & Zapata, P. (2012). Infrastructures, Lock-In, and Sustainable Urban Development: The Case of Waste Incineration in the Göteborg Metropolitan Area. *Journal of Cleaner Production*, 50, 32-39.

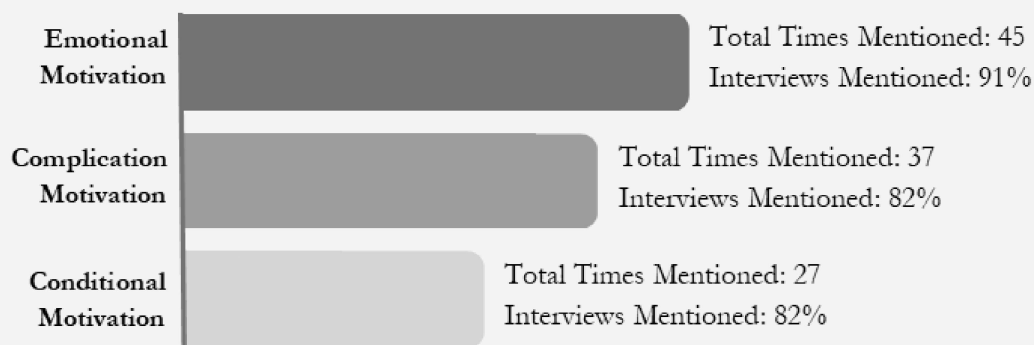
Internal Barrier Categories:

Internal barriers were identified as personal motivators or drivers for policy and strategy makers that may influence the strategic pathways they choose to pursue. Internal barriers were separated into three key categories:

- **Emotional Motivation** related to an emotional tie to the concept or practice of recycling
- **Conditional Motivation** either related to vested interests or resignation to the current condition of things
- **Complication Motivation** tied to uncertainty related to changing course

Category Priority:

In an overview of how frequently each motivation category was discussed in interviews, emotional motivation was the most prominent motive introduced



Most Highlighted Barriers:

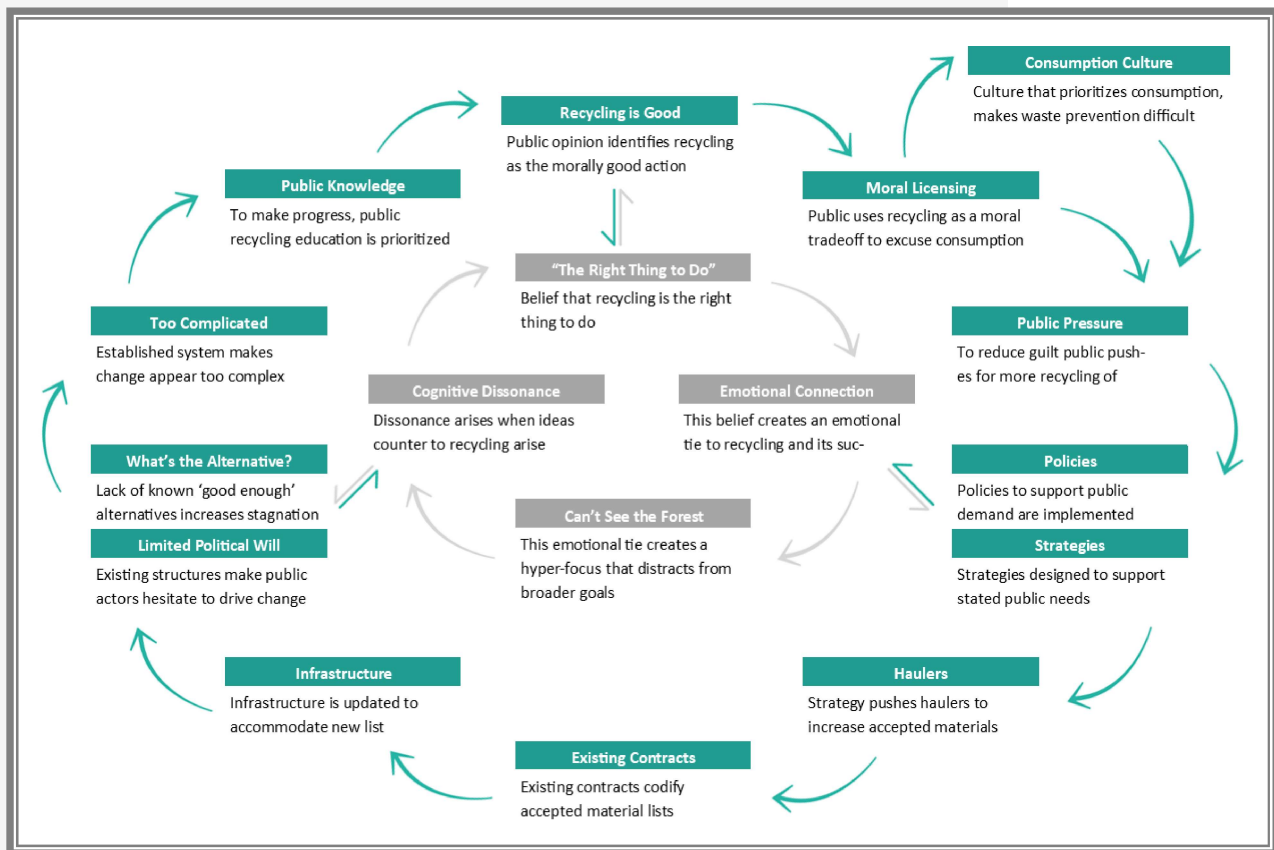
In the interview process, 6 barriers were mentioned the most frequently by interviewees. Percent frequency barriers were mentioned is outlined below.



Feedback Loop Mapping:

Identified internal and external barriers can be **mapped out in feedback loops** to understand how they intersect. This tool can be utilized as a way to understand key leverage points for strategy development and what identify factors act to amplify the problem point the strategy or policy is targeting.

Sample of Feedback Loop Map



Overlapping Barriers

Some barriers were found to **overlap** between internal and external domains, potentially strengthening their influence:

- **Recycling is Good** / The Right Thing to Do
- **Moral Licensing** / Want to Make an Impact
- **Too Complicated** / It's Complicated
- **Change is Hard** / Change is Hard
- **It's not Good Enough** / Is it Good Enough?

For Further Information:

Contact Holly Griffith at
griff.hr@comcast.net

This brief is a summation of detailed thesis research report which can be found at

<https://lup.lub.lu.se/student-papers/search>

Appendix 2: Interview Consent and Overview

THESIS RESEARCH: Investigating the Barriers to Change in Plastic Recycling Policy Development

CONSENT FORM

This form is to ensure that you have been given information about the Thesis project (see Information Sheet on the other side) and to give you opportunity to confirm that you are willing to take part in this research. For all activities below, please indicate which applies to you:

<input type="checkbox"/>	I have been familiarised with the Thesis Research project, I have had the possibility to ask questions and I have received satisfactory answers to my questions
<input type="checkbox"/>	As a research participant, I am aware of my right to withdraw participation at any time
<input type="checkbox"/>	I give my consent that the interview can be audio- and video-recorded , transcribed, and analysed
<input type="checkbox"/>	I understand that the results of the research will be presented so that no information can be traced to me personally
<input type="checkbox"/>	I give my consent that a record of my interview can be safely stored for future reference

Note: Your participation is voluntary. As an interviewee, you do not have to answer all the questions that are asked; you reserve the right to refuse or cease participation in the interview process without stating your reason and may request to keep certain materials confidential.

Please, sign below to confirm your consent:

	Participant(s)	Researcher(s)
Name(s)		
Signature(s)		
Date(s)	21 June 2021	21 June 2021

INFORMATION SHEET

This is an independent research project that has received no external funding

Description of the Research Programme

The products produced by society are not always conducive to existing waste management strategies, particularly when it comes to plastics and recycling. However, changing focus from these standard solutions has proven difficult, and it is clear several barriers exist limiting more sustainable solutions and innovations. This project aims to gather, examine, and advance knowledge about policy development for plastic recycling and its alternatives across 2 states: Washington and Oregon with a focus on 2 cities: Seattle and Portland. The objectives are to understand:

1. EXISTING STRUCTURES of plastics management, how they manifest in a policy sphere, and how they are approached.
2. ALTERNATIVE SOLUTIONS that have been proposed, pursued, and the results of those engagements.
3. BARRIERS TO CHANGE from systems that have proven unsuccessful, if any.

As part of this research programme, I invite you to an interview. I would like to learn more about:

- How policy decisions are made at your team's level and what stakeholders may be involved;
- Current perspectives on plastic recycling and standard solid waste management practices;
- Alternative policies and strategies for plastic waste management that have been employed or discussed (examples include zero waste initiatives or strategies prioritizing repair, reduction, or reuse) and the response to these policies and strategies

The collected material will be used to produce a thesis report on the topic. Research may result in academic publication, an online blog, as well as public communications and a policy brief targeting different actors in interactive ways, e.g. academia, waste management policy makers, and sustainability practitioners. The research results will be accessible upon request.

Data Management

All the data for this project is collected and stored in accordance with the General Data Protection Regulation (GDPR) 2016/679 of the European Union. More information about GDPR implementation at Lund University can be found: lunduniversity.lu.se/gdpr. All the research materials, including the participants' data will be securely stored for the period needed for potential research verification (3 years) in a secure, password protected document. At any stage of the Thesis Research project, the research participants have a right to gain access to their own personal data, request its correction or deletion or limitation to processing of data as well as they can file a complaint about how their personal data is used.

For any enquiries regarding this research, please contact:

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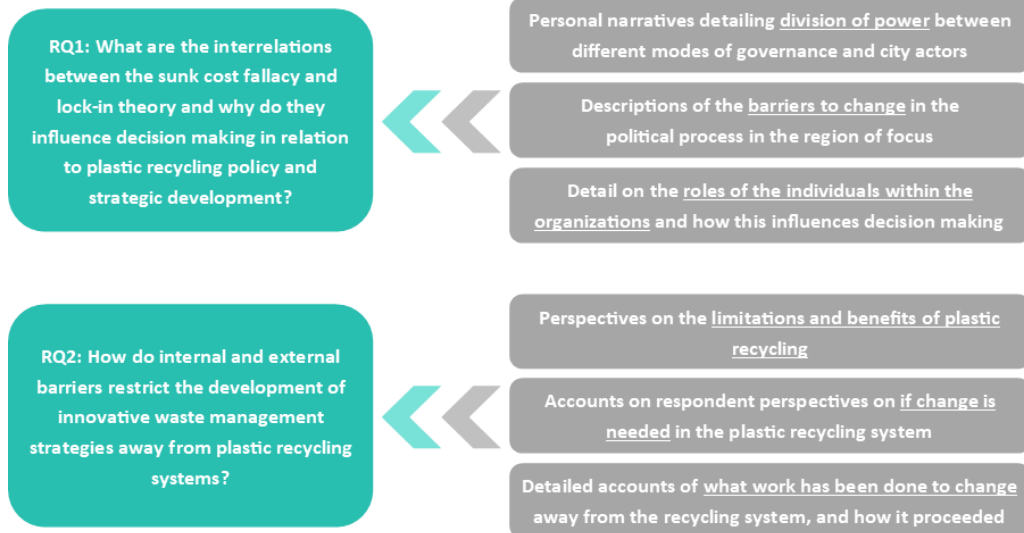
Appendix 3: Interview Guide

Purpose: Perspective Interview

Interview Structure: Semi-Structured

Interviewee: [Respondent Number]

Research Questions:



Occurred On: [Date]

Setting: Interview is occurring over Zoom

Interview Type: Anonymous

Pre-Interview Checklist:

- Send zoom meeting link and calendar invite
- Send consent form before interview
- Verify recording is prepared and backup is ready just in case
- Ensure I-pad log in is host

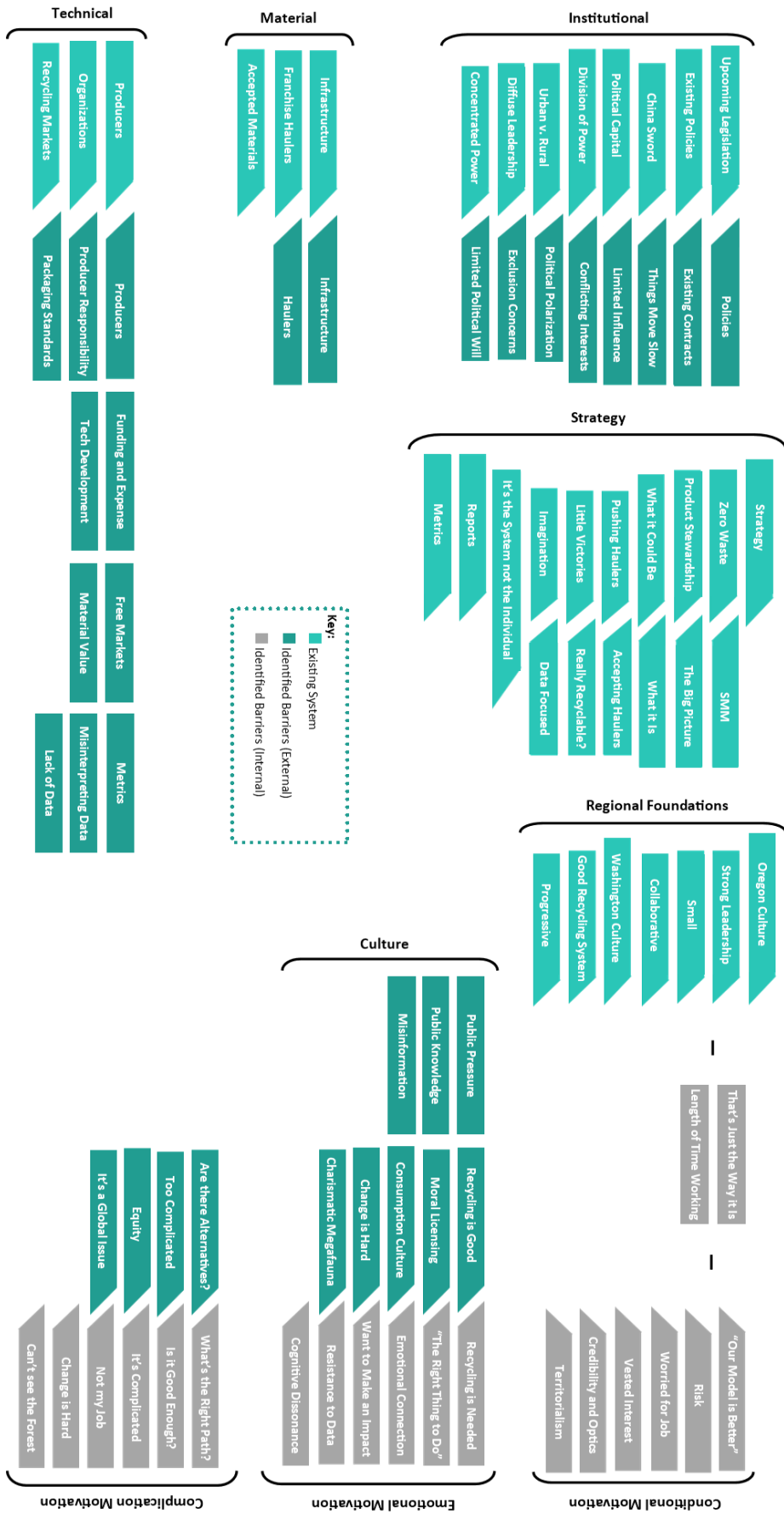
Post-Interview Checklist:

- Send thank you note
- Download recording and transcribe

Agenda:

- Introduction and Greeting (5 Minutes)
 - Introduce purpose of the study and intent of the interview
 - Receive consent for recording and begin recording
 - Verify signature of consent form
 - Obtain consent and any additional expectations for quotation use
- Questions (50 Minutes)
 - **Company and General Overview**
 - *Divisions of Power:*
 - How is your team structured? What are the processes behind inter-organizational decision making?
 - *Roles of Individuals:*
 - How much is strategy direction influenced by individuals versus company/team policy and standards?
 - *Barriers to Change in the System:*
 - Can you run me through the stakeholders that influence policy/strategic decision making?
 - How does the mayor/governor influence the policies and programs pursued if they do?
 - What role does public involvement and interest have in policy direction?
 - What role do interest groups, inter-industry organizations, and companies have in the decision-making process?
 - **Recycling as a System:**
 - What is your perspective on plastic recycling?
 - Is it working? Where does it fail?
 - What are potential tradeoffs between the existing system and more sustainable alternatives?
 - How has plastic recycling been in _____ in the past five years?
 - **Policy Change:**
 - How have zero waste initiatives been received in your work?
 - How have reduction/repair/reuse initiatives been received?
 - Are there any other projects your team has been working on or has worked on in the past that were a different way to approach plastic management?
 - How were those received?
 - By policy professionals in the field?
 - By operations professionals in the field?
 - By other stakeholders in the industry?
 - **Critical Questions/Sunk Cost:**
 - Are there reasons for the industry to be self-critical of policies and the direction we're moving with recycling?
 - Why do we seem to struggle with stepping away from recycling systems? What's holding us back?
 - Probe: Are there any internal restrictions? Why aren't we talking about it?
 - Is recycling enough? What problems does it solve?
 - **Specific Questions:**
 - I've heard quite a bit about _____ program, can you walk me through how implementing that project has gone?
- Closing and Wrap Up (5 Minutes)
 - Verify again quotation permissions and notifications of progress of the work
 - Verify willingness to respond to follow-up questions
 - Thank for time

Appendix 4: Code Map



Appendix 5: Code Description and Overview

Category	Subcategory	Code	Sub-Code(s)	Code Description
Strategy	Strategy	Zero Waste		Statements discussing the Zero Waste strategic framework
		Product Stewardship		Statements outlining current EPR initiatives
		Sustainable Materials Management (SMM)		Statements discussing the SMM strategic framework
		The Big Picture		Statements discussing what the larger goal is, or how strategy should focus on higher targets
		What it Could Be	What it Could Be	Statements relating to a mindset that prioritizes future vision and innovation to develop strategy
			Pushing Haulers	Statements discussing a focus on pushing haulers to improve recycling
		Little Victories	Little Victories	Statements highlighting the perspective that small changes are valuable
			Imagination	Statements about using imagination to support strategy
		What it Is	What it Is	Statements relating to a mindset that prioritizes current systems and data to develop strategy
			Accepting Haulers	Statements discussing listening to hauler limitations and adapting around them
		What it Is	Is it Really Recyclable?	Statements highlighting the materials accepted as recyclable and how recyclable they truly are
		What it Is	Data Focused	Statements about focusing on data to guide strategy
		Reports	It's the System not the Individual	Statements about how change needs to be focused on systemic issues over individual behavior
		Reports	Reports	Statements about existing reports relevant to plastic recycling
Metrics	Metrics	Statements about existing metrics relevant to plastic recycling		
Regional Foundations	Oregon Culture	Differences to Washington		Statements about how Oregon is different from Washington
		Strong Leadership		Statements highlighting Oregon's leadership structure (state focused)
		Small		Statements highlighting how Oregon's smaller size has influenced culture
		Collaborative		Statements highlighting how Oregon's collaborative focus has influenced culture
		Differences to Oregon		Statements about how Washington is different from Oregon
		Good Recycling System		Statements about Washington's current recycling system
		Progressive		Statements about how Washington's progressive priorities have influenced culture
		That's Just the Way it is		Perspectives that policy or strategy changes cannot be made due to system inertia
		Length of Time Working		Perspectives that willingness to change is influenced by length of time in the waste field
		"Our Model is Better"		Perspectives that indicate a regional amplification of one strategic framework against others
Resignation	Resignation	Risk		Perspectives that willingness to change is reduced by the risk of pursuing new pathways
		Worried for Job		Perspectives that willingness to change is reduced by the concern of losing one's job
		Vested Interest		Perspectives that willingness to change is influenced by personal financial or economic interests
		Credibility & Optics		Perspectives that willingness to change is influenced by concerns around a loss of public confidence
		Territorialism		Perspectives that concerns of losing certain domains of control influences willingness to change
Vested Interest	Vested Interest	Worried for Job		Perspectives that willingness to change is reduced by the concern of losing one's job
		Vested Interest		Perspectives that willingness to change is influenced by personal financial or economic interests
		Credibility & Optics		Perspectives that willingness to change is influenced by concerns around a loss of public confidence
		Territorialism		Perspectives that concerns of losing certain domains of control influences willingness to change
		That's Just the Way it is		Perspectives that policy or strategy changes cannot be made due to system inertia

Category	Subcategory	Code	Sub-Code(s)	Code Description
Institutional	Political Structure	Upcoming Legislation		Statements referencing legislation in development that is relevant to plastic recycling
		Existing Policies		Statements referencing existing legislation that is relevant to plastic recycling
		Political Capital		Statements discussing existing political capital or 'momentum' and how it is currently being used
	Division of Power	Division of Power		Statements outlining where power and influence is divided between regional governments of focus
		Urban v. Rural		Statements examining urban and rural perspectives and how they influence policy and strategy
		Diffuse Leadership		Statements outlining current leadership structures and where power is dispersed regionally
	Policies and Strategy	Concentrated Power		Statements outlining current leadership structures and where power is concentrated regionally
		Policies		Explanations regarding how the development of policies can influence future policies and regulations
		Existing Contracts		Explanations regarding how existing contracts create long-term collection priority trajectories
	Established Players	Things Move Slow		Explanations regarding how change in the institutional realm takes time, limiting adaptation potential
		Limited Influence		Explanations regarding the scope of government department influence and where that runs out
		Conflicting Interests		Explanations discussing the multiple interests involved in recycling policy and how they influence development
Technical	Stakeholders	Conflicting Interests		Explanations outlining how stakeholders influence development out of concern of losing influence
		Producers		Explanations outlining how current national climate of polarization is reflected in change discussions
		Organizations		Explanations outlining the lack of political motivation to deal with specific plastic management issues
	Markets	Limited Political Will		Explanations outlining the lack of political motivation to deal with specific plastic management issues
		Recycling Markets		Statements about how producers create plastic material and intersect with plastic recycling system
		Producers		Statements about how others like NGO's or govt. departments intersect with plastic recycling system
	Producers	Producer Responsibility		Statements about how recycling markets currently function including material costs
		Packaging Standards		Explanations regarding how producer practices resist change and how the current system benefits them
				Explanations regarding how packaging standards and development have locked in current state of plastic management
	Cost of the Alternative			Explanations regarding how the lack of financial capital and the expense of alternatives limits change capacity
		Funding and Expense		Explanations of how technological development over time restricts development to specific pathways
		Technological Development		Explanations of how low current value of recycled material influences the ability to fund recycling or new innovative systems
Materials Markets	Free Markets		Explanations of how the 'free market' mindset restricts the ability to influence commodity handling.	
			Explanations regarding how dominant measurement systems have prioritized certain pathways, and the difficulty of measuring alternatives limits the ability to pursue other strategies	
			Explanations regarding how the misinterpretation of data has stymied change	
Metrics	Lack of Data		Explanations regarding the lack of available data to promote more sustainable practices	
	Misinterpreting Data		Explanations regarding the lack of available data to promote more sustainable practices	
			Statements about what materials are currently accepted for plastic recycling	
Existing Infrastructure	Accepted Materials		Statements about current contracted haulers in regions and the influence of these contracts	
	Franchise Haulers		Explanations regarding how existing infrastructure is challenging to move away from and locks in specific development pathways	
	Infrastructure		Explanations of how haulers are motivated to maintain the status quo due to current investments	
Material Built Systems	Infrastructure			
	Haulers			

Category	Subcategory	Code	Sub-Code(s)	Code Description
Cultural	Public Education	Public Pressure		Explanations regarding how public demand for recycling influences policy and strategy development
		Public Knowledge		Explanations regarding how public knowledge around plastic waste best practices influences efficacy of plastic management
	The Recycling Myths	Misinformation		Explanations regarding how misinformation is utilized to influence public opinion
		Recycling is Good		Explanations of how the belief that recycling is the right thing to do influences public support and demand
		Moral Licensing		Explanations of how moral licensing can influence public dedication to recycling practices
		Consumption Culture		Explanations of how consumption culture influences public dedication to recycling practices
		Change is Hard		Explanations of how changing behavior can influence the ability to change end-of-life management strategies
	Dedication	Charismatic Megafauna		Explanations of how the popularity of recycling strategies and policies makes it easier to promote recycling practices other less popular strategies
		Recycling is Needed		Perspectives regarding recycling being a necessary piece of the process, and how that necessity adds complication to personal values and motivations
		"The Right thing to Do"		Perspectives regarding the belief of recycling being a morally good practice creating resistance
		Emotional Connection		Perspectives regarding the emotional tie some professionals hold to the recycling strategy limiting willingness to invest in new strategies
		Want to Make an Impact		Perspectives regarding the desire of industry professionals wanting to help improve the planet
		Resistance to Data		Perspectives regarding the motivations behind ignoring or resisting data that does not support universal recycling
		Cognitive Dissonance		Perspectives regarding how cognitive dissonance can influence strategy and policy making
		Are there Alternatives?		Explanations of how limited clear alternatives makes moving towards change difficult
Complication (External)	Too Complicated		Explanations of how the complication of the issue makes changing stakeholder interest, opinions, and practices difficult	
	Equity		Explanations of how lack of equitable distribution, cooperation, and communication limits efficacy and social sustainability of solutions	
	It's a Global Issue		Explanations of how global nature of waste issues makes regional solution development difficult	
Other	Complication (Internal)	What's the Right Path?		Perspectives engaging with the uncertainty of what the best solution may be, and how this creates hesitation
		Is it Good Enough?		Perspectives engaging with the challenge of alternate solutions not being enough slowing progress
		It's Complicated		Perspectives regarding how complication and the lack of 'black and white' strategies, can create hesitation to engage with the issue
		Not my Job		Perspectives regarding how innovating upstream lies outside the scope of the waste industry
		Change is Hard		Perspectives regarding how change can be challenging, creating resistance to moving away from existing strategies
		Can't See the Forest for the Trees		Perspectives regarding how focus on specific solutions like recycling can distract policy and strategy makers from bigger goals and questions

Category	Subcategory	Code	Sub-Code(s)	Code Description	
Solutions	Institutional	Time		Solutions regarding it taking time to change policies and strategies	
		Model Legislation		Solutions regarding the creation of model legislation that can be used to develop regional policies that reflect it	
		Collaboration		Solutions regarding the collaboration of multiple stakeholder groups	
			Patchwork Pressure		Solutions regarding how regional patchworks of the same, slightly different policy in multiple cities apply pressure to companies being regulated
			Transparency		Solutions regarding increased transparency in data and practices
			Reduction		Solutions regarding increased innovation and increased reduction practices
			Producer Responsibility		Solutions regarding reducing producer change and increased producer responsibility in end-of-life
			Modulated Fees		Solutions regarding setting adapting fees for producers based on what they produce
	Technical		Toxicity Standards		Solutions regarding setting standards around toxic materials used in plastics
			Equity		Solutions regarding improving equity practices in recycling systems
			Time		Solutions regarding it taking time for changes to be made in societal consciousness
	Cultural		Storytelling		Solutions regarding improving messaging systems for sustainable waste strategies
			Reuse Innovation		Solutions regarding improving reuse practices, infrastructure, and messaging
			Leverage Momentum		Solutions regarding utilizing existing messaging and public drive towards different strategy initiatives
	Material		Bottle Bill		Solutions regarding implementing a bottle bill to improve source separation

Appendix 6: Code Frequency and Analysis

Category	Subcategory	Code	Sub-Code(s)	Interviews Mentioned	% Interviews Mentioned	OR Interviews Mentioned	OR % Mentioned	WA Interviews Mentioned	WA % Mentioned
Strategy	Strategy	Zero Waste		3	27%	0	0%	3	50%
		Product Stewardship		3	27%	1	20%	2	33%
		Sustainable Materials Management (SMM)		2	18%	2	40%	0	0%
		The Big Picture		8	73%	5	100%	3	50%
		What it Could Be		5	45%	2	40%	3	50%
	Records/Data	What it is		3	27%	3	60%	0	0%
		It's the System not the Individual		3	27%	1	20%	2	33%
		Reports		5	45%	2	40%	3	50%
		Metrics		2	18%	0	0%	2	33%
		Differences to Washington		1	9%	1	20%	0	0%
	Oregon Culture	Strong Leadership		4	36%	4	80%	0	0%
		Small		2	18%	2	40%	0	0%
		Collaborative		3	27%	3	60%	0	0%
		Differences to Oregon		3	27%	1	20%	2	33%
		Good Recycling System		3	27%	1	20%	2	33%
Washington Culture	Progressive		2	18%	1	20%	1	17%	
	Length of Time Working		2	18%	2	40%	0	0%	
	That's Just the Way it Is		2	18%	0	0%	2	33%	
	"Our Model is Better"		5	45%	3	60%	2	33%	
	Risk		3	27%	2	40%	1	17%	
Regional Foundations	Vested Interest	Worried for Job		2	18%	0	0%	2	33%
		Vested Interest		1	9%	0	0%	1	17%
		Credibility		3	27%	0	0%	3	50%
		Territorialism		2	18%	1	20%	1	17%
		Upcoming Legislation		8	73%	4	80%	4	67%
Institutional	Political Structure	Existing Policies	Existing Policies	2	18%	1	20%	1	17%
		Political Capital	China Sword	7	64%	4	80%	3	50%
		Division of Power	Division of Power	2	18%	1	20%	1	17%
		Urban v. Rural	Urban v. Rural	2	18%	2	40%	0	0%
		Diffuse Leadership	Diffuse Leadership	2	18%	1	20%	1	17%
	Policies and Strategy	Concentrated Power		2	18%	2	40%	0	0%
		Policies		4	36%	2	40%	2	33%
		Existing Contracts		2	18%	1	20%	1	17%
		Things Move Slow		3	27%	2	40%	1	17%
		Limited Influence		8	73%	3	60%	5	83%
Established Players	Conflicting Interests	Conflicting Interests	Conflicting Interests	7	64%	2	40%	5	83%
		Exclusion Concerns	Exclusion Concerns	2	18%	2	40%	0	0%
		Political Polarization	Political Polarization	3	27%	1	20%	2	33%
		Limited Political Will	Limited Political Will	1	9%	1	20%	0	0%

Category	Subcategory	Code	Sub-Code(s)	Interviews Mentioned	% Interviews Mentioned	OR Interviews Mentioned	OR % Mentioned	WA Interviews Mentioned	WA % Mentioned	
Technical	Stakeholders	Producers		2	18%	2	40%	0	0%	
		Organizations		2	18%	1	20%	1	17%	
	Markets	Recycling Markets		2	18%	2	40%	0	0%	
		Established Players		5	45%	2	40%	3	50%	
	Producers	Producer Responsibility		7	64%	1	20%	6	100%	
		Packaging Standards		2	18%	0	0%	2	33%	
	Cost of the Alternative	Funding and Expense		10	91%	4	80%	6	100%	
		Technological Development		2	18%	0	0%	2	33%	
	Materials	Recyclable Material Value		5	45%	2	40%	3	50%	
		Free Markets		3	27%	0	0%	3	50%	
Metrics	Metrics		5	45%	1	20%	4	67%		
	Misinterpreting Data		2	18%	1	20%	1	17%		
Material	Existing Infrastructure	Lack of Data		4	36%	1	20%	3	50%	
		Accepted Materials		5	45%	3	60%	2	33%	
	Built Systems	Franchise Haulers		3	27%	3	60%	0	0%	
		Infrastructure		9	82%	3	60%	6	100%	
	Public Education	Established Players		3	27%	1	20%	2	33%	
		Public Pressure		6	55%	4	80%	2	33%	
	Cultural	The Recycling Myths	Public Knowledge		8	73%	3	60%	5	83%
			Misinformation		1	9%	0	0%	1	17%
		Dedication	Recycling is Good		7	64%	3	60%	4	67%
			Moral Licensing		7	64%	3	60%	4	67%
The Recycling Myths		Consumption Culture		6	55%	2	40%	4	67%	
		Change is Hard		2	18%	0	0%	2	33%	
Dedication		Charismatic Megafuna		5	45%	1	20%	4	67%	
		Recycling is Needed		7	64%	3	60%	4	67%	
Dedication		"The Right thing to Do"		7	64%	3	60%	4	67%	
		Emotional Connection		3	27%	2	40%	1	17%	
Dedication	Want to Make an Impact		2	18%	1	20%	1	17%		
	Resistance to Data		4	36%	4	80%	0	0%		
Dedication	Cognitive Dissonance		2	18%	2	40%	0	0%		

Category	Subcategory	Code	Sub-Code(s)	Interviews Mentioned	% Interviews Mentioned	OR Interviews Mentioned	OR % Mentioned	WA Interviews Mentioned	WA % Mentioned
Other	Complication (External)	Are there Alternatives?		1	9%	0	0%	1	17%
		Too Complicated		4	36%	2	40%	2	33%
	Equity	Equity		4	36%	2	40%	2	33%
		It's a Global Issue		3	27%	1	20%	2	33%
	Complication (Internal)	What's the Right Path?		3	27%	0	0%	3	50%
		Is it Good Enough?		3	27%	2	40%	1	17%
		It's Complicated		5	45%	1	20%	4	67%
		Not my Job		2	18%	0	0%	2	33%
		Change is Hard		5	45%	2	40%	3	50%
		Can't See the Forest for the Trees		6	55%	2	40%	4	67%
Time			1	9%	1	20%	0	0%	
Model Legislation			2	18%	1	20%	1	17%	
Solutions	Institutional	Collaboration		1	9%	0	0%	1	17%
		Patchwork Pressure		1	9%	1	20%	0	0%
		Transparency		1	9%	0	0%	1	17%
		Reduction		1	9%	0	0%	1	17%
	Technical	Producer Responsibility		5	45%	2	40%	3	50%
		Modulated Fees		1	9%	0	0%	1	17%
		Toxicity Standards		1	9%	0	0%	1	17%
Cultural	Equity		1	9%	1	20%	0	0%	
	Storytelling		2	18%	1	20%	1	17%	
	Reuse Innovation		2	18%	0	0%	2	33%	
	Leverage Momentum		1	9%	1	20%	0	0%	
Material	Material	Bottle Bill		1	9%	0	0%	1	17%