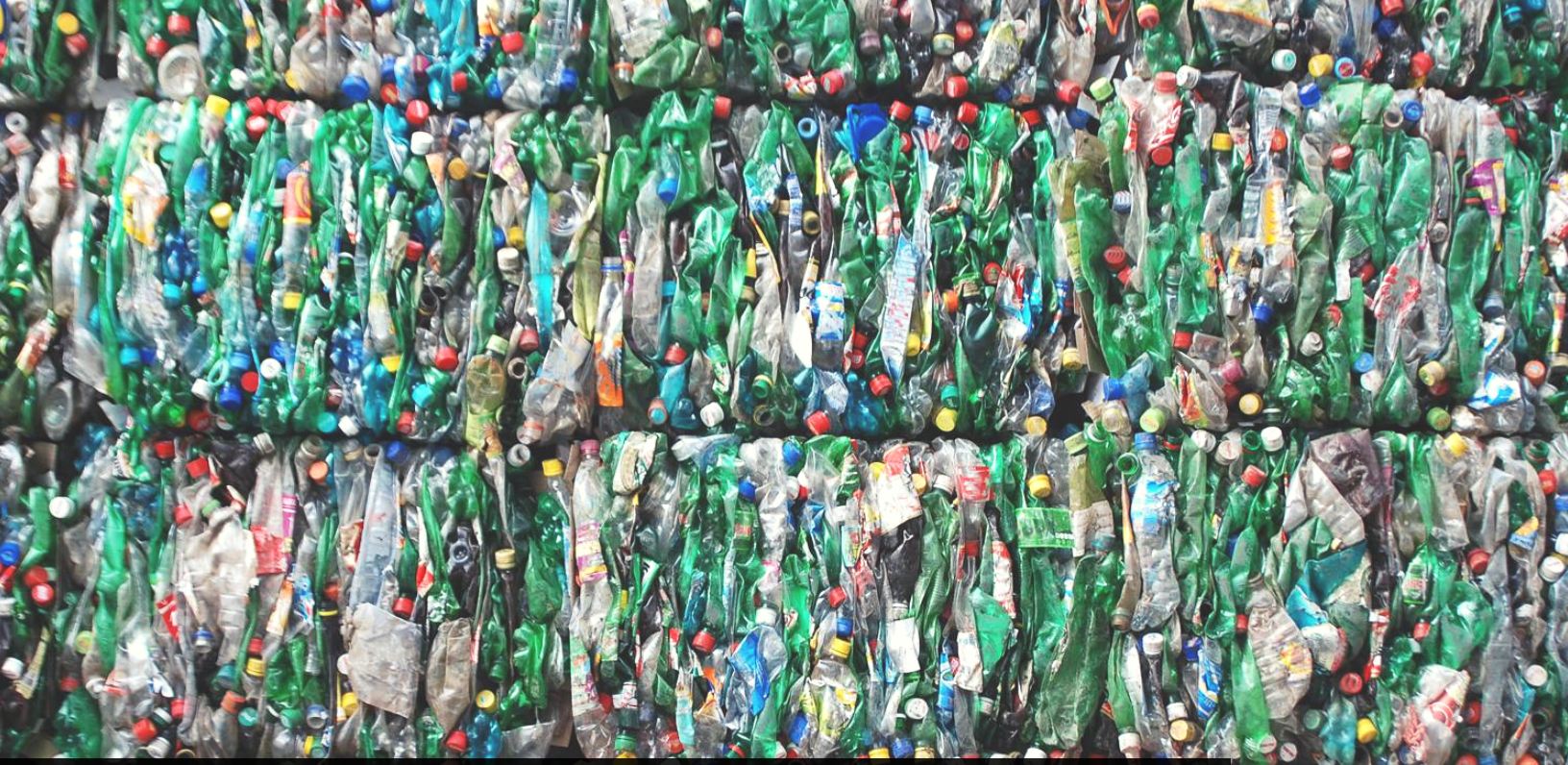

WASHINGTON STATE'S

RECYCLING DEVELOPMENT CENTER

Developing Secondary Markets for Recycled Materials in the Pacific Northwest

WASHINGTON STATE'S

RECYCLING DEVELOPMENT CENTER

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Executive Summary

In April 2019, the Washington State Legislature passed House Bill 1543 to create a Recycling Development Center (Center) to provide or facilitate research and development, marketing, and policy analysis to bolster recycling markets and processing in Washington. Anticipating the potential passing of HB 1543, the Washington State Department of Ecology (Ecology) contracted with the University of Washington's Evans School of Public Policy and Governance Student Consulting Lab. In December 2018, we began working with Ecology to create a report that would support the implementation of the new Recycling Development Center.

Our study used interviews and case studies to answer the question: **What are the most effective approaches that the Washington Recycling Development Center can take to reduce overall waste and increase recycling rates in response to changing markets and China's National Sword policy?**

Based on interviews with 31 industry professionals and 11 case studies of government programs, recycling development councils, and other recycling partnership models, we recommend that Ecology consider prioritizing the following options:

1) *Develop a Regional Partnership* – The Center should establish a regional partnership model, consider British Columbia and Oregon as potential partners, delegate to Recycling Development Center staff to manage these partnerships, and maintain consistent communication with potential partners.

2) *Create an Accelerator Program* – The Center should develop and implement an accelerator program to bolster a diverse recycling market through intentional business development support and resources.

3) *Research Strategies to Attract Manufacturing Facilities Using Recycled Feedstocks* – The Center should analyze Washington State's relative attractiveness to manufacturing facilities interested in using recycled feedstock and recommend and implement a model to increase its competitiveness and realize the benefits of this activity.

4) *Develop Two Public Databases to Better Connect Industry Stakeholders* – The Center should provide a digital database for manufacturers and recycling processors to build relationships and share knowledge, tapping the potential high market impacts of those relationships.

5) *Research Infrastructure Needs* – The Center should explore the development of a plastic recycling facility (PRF) and consider siting a PRF in close proximity to an existing material recovery facility (MRF) in a densely populated area of the state.

Acknowledgements

We would like to first and foremost thank the Washington State Department of Ecology for giving us the opportunity to work on this project. In particular, we are grateful to Julie Robertson, Laurie Davies, and other Ecology staff who shared their time, resources, insights, and feedback with us as we developed this report.

We would like to express our gratitude to our professor and advisor Matt Steuerwalt who provided ongoing guidance and feedback throughout this report.

Finally, we would like to thank the industry professionals we interviewed for their invaluable insights and feedback. These interviews helped us understand the developing recycling landscape and guided our recommendations.

Thank you.

Chapter One: Introduction

1.1 Report Overview

Recycling in Washington State is a growing concern, and in April 2019, the Washington State Legislature passed House Bill 1543 to create a Recycling Development Center (Center) in the state. The Center is housed within the Washington State Department of Ecology (Ecology) in partnership with the Department of Commerce (Commerce) and is mandated by law to provide or facilitate research and development, marketing, and policy analysis to bolster recycling markets and processing in Washington. This law's passage comes at a time when recyclers increasingly struggle to find markets for recycled materials in the face of rising contamination standards, volatile international markets, and dwindling local buyers.

In December 2018, Ecology contracted with the University of Washington's Evans School of Public Policy and Governance Student Consulting Lab to prepare for the new Recycling Development Center in Washington. This study used interviews and case studies to answer the question: **What are the most effective approaches that the Washington Recycling Development Center can take to reduce overall waste and increase recycling rates in response to changing markets and China's National Sword policy?** This report has six chapters that are organized as follows:

- In *Chapter Two: Background and Review of Literature*, we provide context for changing recycling markets, review the regulatory context, and explore the literature on recyclable materials, recycling market trends, and financial opportunities in Washington State.
- In *Chapter Three: Research Methodology*, we provide an overview of our research process.
- In *Chapter Four: Findings*, we present the results of the case studies and interviews with industry professionals.
- In *Chapter Five: Recommendations and Work Plan*, we provide recommendations for the Recycling Development Center, as well as a work plan for the first two years of the Center.
- In *Chapter Six: Conclusion*, we provide a brief conclusion of the purpose and outcome of the report.
- In the *Appendices*, we include a list of interviewees, a case study matrix, a regulatory list, a life-cycle energy analysis comparing virgin inputs to recycled inputs, and an interview findings matrix.

Chapter Two: Background and Review of Literature

2.1 China National Sword

Washington first required recycling in 1989 with the Waste Not Washington Act, and by 1991, 85 percent of Washington residents had access to curbside recycling.[1] As a western state with proximity to the Pacific Rim markets, Washington had access to growing markets for these recycled materials. Recycling companies became heavily reliant on exporting the materials they collected through recycling programs to Asian countries, mainly China. International cargo companies who shipped Chinese-produced goods to the United States offered low shipping costs to American recyclers in cargo containers that would otherwise return empty. In 2016, Washington State recycling companies shipped 790,000 metric tons of materials to China through the ports of Seattle and Tacoma.[2]

However, contamination of bales sent overseas had been a major problem for decades. Contamination occurs when a non-recyclable material, or the incorrect recyclable material, ends up in a bale of recyclable materials; food is a common contaminant, as are broken glass and plastic bags. Contamination is a serious issue and can reduce efficiency and lower the value of the bale significantly. But because bales of recycled materials were low-cost to send overseas, and because recycled materials were in such high demand, few restrictions were placed on contamination levels until recently.

In 2017, China announced its National Sword Policy, which banned the import of 24 types of recycled commodities and limited the amount of contamination on other materials to below 0.5 percent.[3] Since the typical contamination level for recycling falls between three and five percent, the policy effectively bans the importation of these materials from the current U.S. recycling processing system.[4] This policy became effective in early 2018 and was expanded to include an additional 32 materials in April 2018.[5]

As a result, recyclers in Washington State have had to ask for permission to landfill materials,[6] cities have suspended their recycling programs,[7] municipalities have restricted the types of materials they will accept,[8] and rates have had to rise as materials that formerly generated revenue now cost haulers and processors money.[9] While some recyclers have found markets in other Southeast Asian countries, this does not offer a long-term solution, since these countries are also beginning to increase restrictions of scrap imports.[10] With a large amount of collected material from its recycling programs, Washington State faces an issue of how to divert this waste from the landfill to appropriate markets.

2.2 Regulatory Context

The new Recycling Development Center does not exist in a vacuum; it will need to adhere to Washington State's existing regulatory framework. The Recommendations in *Chapter Five* were developed with this framework in mind to determine which recommendations are politically and legally feasible and which policies could be translated into tools to advance the Center's purpose to reduce waste and increase material recovery. The state's solid waste policy is defined by several legislative bills that have passed since 1969.

Most recently, the Washington State Legislature passed House Bill (HB) 1543[11]—an act relating to sustainable recycling in 2019. HB 1543 amends sections of chapter 70.95 RCW, chapter 70.93 RCW, and adds a new chapter to Title 70 RCW. The bill states the value of recycling and waste reduction and stresses the importance of recycling commodity markets in response to strict international regulations. HB 1543 also creates the Recycling Development Center within Ecology. According to the bill:

> "The purpose of the center is to provide or facilitate basic and applied research and development, marketing, and policy analysis in furthering the development of markets and processing for recycled commodities and products. As used in this chapter, market development consists of public and private activities that are used to overcome impediments preventing full and productive use of secondary materials diverted from the waste stream and that encourage and expand use of those materials and subsequent products. In fulfilling this mission, the center must initially direct its services to businesses that transform or remanufacture waste materials into usable or marketable materials or products for use rather than disposal."[12]

The new law also outlines a number of activities pertaining to the above purpose, and mandates an advisory board to advise the Center. In parallel with the work of the Center, the bill mandates contamination and reduction plans in any comprehensive waste management plan by July 1, 2021.

2.2.1 Overview of Revised Code of Washington

Solid waste planning in the State of Washington is regulated by the Revised Code of Washington (RCW), and specifically chapter 70.95 RCW Solid Waste Management—Reduction and Recycling.[13] The last major guideline revision of 70.95 was in 1999; relevant changes since then include permit exemptions regarding beneficial use (RCW 70.95.305) and the transport and handling of recyclable materials (RCW 70.95.400-440). Local governments prepare comprehensive solid waste management plans, and Ecology is responsible for the review and approval of these plans (RCW 70.95.094). For a list of the most pertinent sections of chapter 70.95 RCW, see Appendix 3.

2.2.2 Department of Ecology Responsibility

Ecology is responsible for providing technical assistance, such as planning guidelines, to cities to help them prepare, review, and revise their waste management plans and information related to unique local recycling and reduction plans (RCW 70.95.100).[14] Ecology is also responsible for developing a comprehensive public education program to encourage waste reduction, source separation, and recycling as well as operating a toll-free public information hotline.

According to RCW 70.95.263, Ecology is also responsible for developing a statewide comprehensive waste management plan in coordination with other state departments.[15] Ecology is authorized by RCW 70.95.268 to disburse funds to local governments to help them develop solid waste recovery or recycling projects.[16] Finally, RCW 70.95.280 through RCW 70.95.295 mandate Ecology to develop best practices for solid waste management, including waste reduction and recycling, through waste stream evaluations and analyses, and to incorporate findings into the state's comprehensive plan.[17]

2.2.4 Comprehensive Waste Management Plans

Local counties and cities are required by RCW 70.95.110 to adopt comprehensive waste management plans.[18] According to the RCW 70.95.080, the purpose of the comprehensive plans is "to plan for solid waste and materials reduction, collection, and handling and management services and programs throughout the state, as designed to meet the unique needs of each county and city in the state."[19] RCW 70.95.090 defines the required contents of these waste management plans.[20] Importantly, the requirements include the creation of a comprehensive waste reduction and recycling program. We explore this further in *2.2.6 Recyclable Materials* below. The plans may span more than one county and must be created in cooperation with the cities located within the county (RCW 70.95.080).[21]

The State of Washington also has a comprehensive waste management plan, called the Beyond Waste and Toxics plan,[22] spanning a 20-year horizon. As stated previously, Ecology is responsible for developing the plan. Components of the plan include data management, materials evaluations, market identification, strategies for incentives, and technical assistance for local jurisdictions. Importantly, the plan also includes research and data to develop solid waste recovery and recycling projects throughout the state (RCW 70.95.260 and RCW 70.95.263).

2.2.5 Waste Handling and Rates

The state defines solid waste handling as "the management, storage, collection, transportation, treatment, utilization, processing, and final disposal of solid wastes, including the recovery

and recycling of materials from solid wastes, the recovery of energy resources from solid wastes or the conversion of the energy in solid wastes to more useful forms or combinations thereof" (RCW 70.95.030).

According to RCW 35.21.120, a municipality establishes the system(s) of solid waste handling in its jurisdiction. The handling may be through the city itself or can be contracted out to private firms. This section of the RCW also outlines fees a city must pay a private contractor. State regulations allow several ways for waste collection to be handled in municipalities.[23] Municipalities may provide all collection and billing services, or work with private haulers to delegate some or all of the collection and billing services. If a municipality does not provide collection service or contract for such service, the Washington Utilities and Transportation Commission (WUTC) sets the service area and rates (RCW 35.02.160). Unincorporated areas in counties (RCW 36.58 RCW; RCW 81.77) must use the WUTC Franchise service providers.

In 2005, an amendment to RCW 70.95 passed that required transporter registration and recycling facilities notification with penalties for noncompliance. This amendment ensures that recyclable materials from commercial and industrial facilities are transported to MRFs or companies that reuse recyclable materials, and not to disposal facilities or landfills.

2.2.6 Recyclable Materials

RCW 70.95.030 defines recyclable materials as "those solid wastes that are separated for recycling or reuse, such as papers, metals, and glass, that are identified as recyclable material pursuant to a local comprehensive solid waste plan." Conversely, solid waste(s) is defined in the chapter as "putrescible and non-putrescible solid and semi-solid wastes including, but not limited to, garbage, rubbish, ashes, industrial wastes, swill, sewage sludge, demolition and construction wastes, abandoned vehicles or parts thereof, and recyclable materials."[24]

Per the required county and city comprehensive waste management plans, jurisdictions are required to include waste reduction and recycling plans that "reduce the amount of waste generated, provide incentives and mechanisms for source separation, and establish recycling opportunities for the source separated waste."[25] The recycling program should be supported by data, such as existing recyclable markets, waste generation trends, and waste composition; a description of existing programs and program needs; and an implementation schedule for designated recyclable materials.

2.3 Materials

An assessment of recovered materials is crucial in answering what commodities the Center should focus on. Such an assessment depends on factors, including market demand and the economic and environmental benefits and costs. We analyzed relevant materials literature on the four major categories of recycled materials: paper products, plastics, glass, and metals. Figures 1,

2, and 3 provide information on the environmental benefits of recycling materials including the energy reduction from recycling—pulled from the U.S. EPA Waste Reduction Model (WARM) analysis—as well as environmental concerns with landfilling, an overview of the market elements of each material, and larger industry trends.

- *Paper products* – Corrugated cardboard, mixed paper, and newspaper are the most widely accepted recycled materials and are easily processed. Paper products face significant issues with contamination, however, and were the markets hardest hit by China's National Sword policies.

- *Plastics* – Plastics are organized into seven major categories, and recycling varies widely between them. Plastics pose the most health risks when landfilled but can be difficult to process, and some types require secondary processing to be marketable. There are strong export markets for some types of plastics, but those markets can be volatile.

- *Glass* – Glass is widely accepted and does produce some environmental benefit from recycling. It breaks frequently during the process and poses unique recycling challenges because of this. Of all the materials, glass has the most localized markets and does not currently have an export market.

- *Metals* – Metals are a small but healthy portion of the recycling market and pose minimal challenges.

Figure 1: Detailed Overview of Recycling Paper Products (Corrugated Cardboard, Mixed Paper, and Newspaper)

Material		Secondary Use	Energy Reduction from Recycling[1]	Environmental Concerns with Landfilling	Recycling Markets Elements			
					Recycling	Processing	End Markets	
							Domestic	Export
Paper Products (14.9%[2])	**Corrugated Cardboard**	Liner, boxboard, and paper bags.	53%	none	Collected in ALL programs (100%)	Easily and effectively sorted in MRFs Less ideal for sorting if wet or food contaminated Smaller pieces of cardboard miss-sorted into other paper streams	Local markets in Longview, WA and in Oregon	Significant effect from National Sword
	Mixed Paper	Liner, corrugated cardboard, kraft pulp	n/a	none	Collected in ALL programs (100%) Quality of materials collected is fair but decreasing	Shredded paper is too small to be sorted by MRFs and contaminates other commodities Less ideal for sorting if wet or food contaminated	No local mills accept mixed paper from Pacific Region MRFs because of high contamination	Significant effect from National Sword
	Newspaper	Paper, hardback books, newspaper, phone books, advertising inserts, paper bags	46%	none	Collected in ALL programs (100%) Quality of materials is fair, dependent on dry	Challenge to keep the newspaper uncontaminated during processing, increasing contamination over time	No local mills accept newspaper from Pacific Region MRFs because of high contamination	Significant effect from National Sword

Figure 2: Detailed Overview of Recycling Plastics (#1-7)

Material		End Use	Energy Reduction from Recycling	Environmental Concerns	Recycling Markets Elements			
					Recycling	Processing	End Markets	
							Domestic	Export
Plastics (10.2%[3])	**#1 PET/PETE**	Textiles, carpets, pillow stuffing, boat sails, auto parts, shoes, luggage, winter coats	50%	**High** - Plastics that escape landfilling are a persistent marine pollutant[4] and pose a toxic health risk[5].	Collected in ALL programs (100%)	The quality of plastics collected in commingled recycling systems is fair Separation uses a combination of hand and machine sorting Often baled materials are shipped to a secondary processor (PRF) for further sorting Plastic bags and film tangle in machine gears and are often too contaminated or low quality to recycle High contamination from food Yield loss due to caps and labels of plastic bottles[6]	Major established domestic markets Market can be volatile	Strong export markets
	#2 HDPE	Plastic crates, lumber, fencing	71%				Major established domestic markets Market can be volatile Barrier is that there is not enough price advantage over virgin resin[7] Manufacturers stated that the most common piece of equipment they needed was a vented or vacuum-degassing extruder[8]	Strong export Markets can be volatile
	#3 - #7 PVC, LDPE, PP, PS, and Other Plastics		n/a		Collected in SOME programs (7% - 49%) Many are not collected in programs		Only non-bottle rigid film and expanded polystyrene have established US markets Volatile	Only plastic resins and PP have strong export markets Markets can be volatile

Figure 3: An Overview of Recycling Glass and Metals

Material		Secondary Use	Energy Reduction from Recycling	Environmental Concerns	Recycling Markets Elements			
					Recycling	Processing	End Markets	
							Domestic	Export
Glass (2.3%)		Jars, bottles, and culet	34%	**Few** - glass is an inert and nontoxic material that does not contribute to pollution in landfills.[9]	Collected in MOST programs (98%)	Glass breaks and poses a safety risk to workers.[10]	Exclusively local markets for recycled glass	No current export markets exist
Metals (5.8%)	**Aluminum**	Cans, foil food trays, mixed metals	96%	None	Collected in ALL programs (100%)	Aluminum foil, trays, and pans are often food contaminated and are difficult to sort.[11]	About half of the market for aluminum is domestic	High export demand
	Steel		56%	None			Nearly all of the market is domestic	Slowing export demand

2.4 Recycling Market Trends

Since China's National Sword, most local and state governments have focused their recycling efforts on trying to reduce contamination by restricting certain material categories through educational campaigns on what types of materials to recycle, switching back from a single stream to a dual stream, or fining citizens or municipalities that have recycled products with high contamination levels.[26] Other municipalities have invested in updating MRF technology to improve processing capabilities[27]; major recyclers, including Recology[28] and Waste Management,[29] have invested millions of dollars into technological improvements, such as installing optical sorters and sorting robots. While reducing contamination should always be a goal of recycling programs, these efforts will most likely not reopen the Chinese market to U.S. haulers, as the 0.5 percent contamination restriction has been noted to be "all but unachievable," especially when factoring in the price of reaching that level.[30]

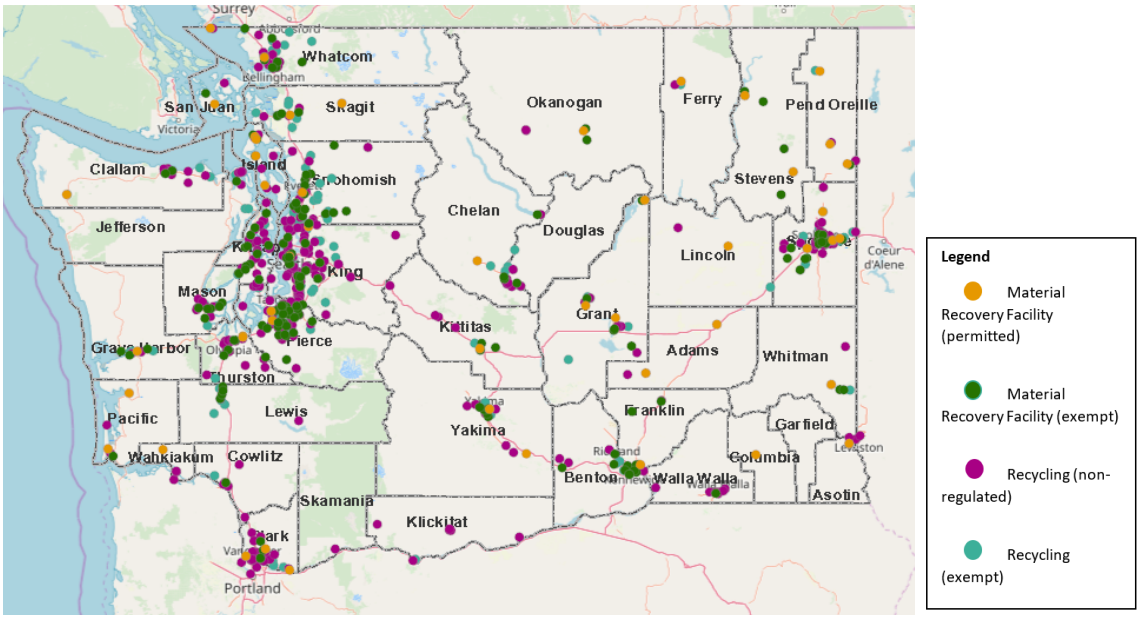
Looking beyond contamination, haulers have shifted the countries where they send their processed materials; instead of sending these exports to China, they are being shipped to other Southeast Asian countries and India.[31] While these shifts in markets provide temporary relief to the stressed recycling system, Vietnam[32], Malaysia[33], and Thailand[34] have plans to limit or ban certain categories of waste imports. Therefore, other market solutions will need to be developed for the long-term benefit of U.S. recycling.

To address this issue, manufacturers are increasing the capacity for domestic recycled paper. Late in 2018, the Northeast Recycling Council (NERC) announced a list of 17 U.S. paper mills, which will increase the facilities' ability to utilize recycled paper as a feedstock; these facilities will specifically target the use of old corrugated containers and residential mixed paper.[35]

2.5 Recycling Processing Facilities in Washington State

All materials collected for recycling from residents in the State of Washington go to a MRF. The MRF accepts, sorts, processes, and bales different types of recyclables. The MRF bales recyclables for shipment and sale to a secondary processor or end-user.[36] Ecology's most recent report of recycling processing facilities indicated 264 MRFs and 681 recycling facilities currently operate in Washington State. As seen in Figure 4, many of these are located in Western Washington, and are located near densely populated areas. There are currently no recovery facilities that specialize in only plastics or containers in Washington State. Additionally, mixed paper makes up a large percentage of the residential waste stream. Although mixed paper is routinely processed in MRFs throughout the state and previously had strong export markets, the majority of bales produced by MRFs as feedstock for end-use manufacturers were exported to China before its recent policy changes. It has environmental benefits when used as a feedstock for making fiber products.

Figure 4. Washington State Recycling and Material Recovery Facilities[37]



2.5.1 Plastic Recovery Facilities

Most MRFs are able to process plastics #1 and #2, but #3 through #7 pose additional difficulty for such facilities. As a result, approximately 40 percent of communities across the United States do not collect and recycle #3 through #7 plastics due to the lack of accessible processing technology. According to EPA's 2018 Report "Advancing Sustainable Materials Management," the amount of post-use, recoverable plastics landfilled in the United States in 2015 was estimated at 26.0 million tons.

Plastic bales from MRFs that include all polymer grades must be further sorted for optimal post-consumer end use. Traditionally, mixed plastics must be separated for optimal end use due to their different melting temperatures. When plastics of all grades are melted together, separation occurs and reduces the strength of the recycled material, limiting its use. Moreover, fillers and dyes used to create virgin plastics further complicate the recovery process. A Plastic Recovery Facility (PRFs) is a technology that uses an optical scanner to sort mixed plastics according to their polymer grade (1-7). Depending on the facility, sorted polymers can be processed into bales or converted into flakes, pellets, preforms, extruded sheets, or other secondary products.

PRFs help create a secondary market for mixed-polymer bales produced by MRFs. They also reduce the cost and time required of MRFs to process post-consumer plastic waste. Finally, PRFs create direct societal benefits through job creation, waste diversion, and carbon emission reduction.

2.6 Financial Assistance Opportunities in Washington State

While the Washington State constitution places restrictions on the money that can be given or loaned to an individual, company or corporation, the state's Department of Commerce offers financing opportunities that could apply to the Center's work. Depending on the projects prioritized by the Center's staff, these could help fund new types of recycling facilities, innovative manufacturing processes, and processing facilities in more rural parts of the state. These opportunities include:

- *Public Works Board* – Authorized by RCW 43.155, this entity can loan money to local municipalities in Washington State for the purpose of developing or repairing public work projects, such as solid waste and recycling facilities under the current statute.[38] These loans can amount to up to $1 million in pre-construction costs and up to $10 million construction costs. These loans should be researched to determine their appropriateness for improving recycling processing, such as the creation of a plastics recovery facility in Washington.

- *Community Economic Revitalization Board (CERB)* – Local municipalities can apply for both loans and grants from the CERB. Projects must provide an economic development outcome, which includes private business investment or job creation.[39] While recycling or solid waste facilities do not meet the criteria for the main list of eligible projects, the state authorized the development of incubation facilities within certain Innovation Partnership Zones (IPZs). These zones foster partnerships between the government and targeted private companies to increase certain forms of development. Currently, one such zone, Grays Harbor, focuses on sustainable industry, encouraging the growth of business practices that increase the use of renewable, recycled, and sustainable products.[40] The funding schemes of the CERB vary by project type, but the CERB could potentially offer funding for an innovative recycling facility or manufacturing process using recycled feedstock.

- *Clean Energy Fund* – As discussed in *Section 4.2.2*, CalRecycle—California's state recycling agency—has supplied loans through its Greenhouse Gas Reduction Loan Program to local recycling projects that can demonstrate a greenhouse gas reduction tied to their operations. Following this approach, the Washington state Clean Energy Fund could provide an opportunity to reduce greenhouse gas emissions through recycling projects and developing infrastructure to improve recycling rates for environmentally beneficial materials.[41]

There are numerous additional grant programs administered by Washington State agencies intended to create public benefit, including several in Ecology. While these grant programs are likely not applicable to recycling today, they might serve as a model for future programs to support infrastructure for recycling markets in the state. In addition, Washington State offers tax incentives for certain green or renewable energy activities, such as the sales tax exemption already in place for anaerobic digesters and biogas processing equipment.[42] These types of tax

incentives create a model that could provide a sales and operations tax exemption for recycling processing equipment from the Department of Revenue, if the Legislature pursued such a policy.

2.7 Other Relevant Resources and Reports

There are numerous other relevant reports that discuss what we have brought up here, both specific to the Washington context and more general to the West Coast:

- *2015–2016 Washington Statewide Waste Characterization Study* – The Washington Department of Ecology worked with Cascadia Consulting Group to compile a municipal solid waste characterization study. Initially conducted and updated in 2018, the study in an exhaustive look at the materials and resources that are currently disposed of in Washington. The complete report can be found here: https://fortress.wa.gov/ecy/publications/documents/1607032.pdf

- *Northwest Region Report* – The Washington Department of Ecology's Northwest Region compiled a regional report that provides an overview of all recyclable materials, which we relied on heavily for this report. The complete report can be found here: https://fortress.wa.gov/ecy/publications/documents/1607028.pdf

- *Recycling Market Development in the United States* – The Oregon Department of Environmental Quality (Oregon DEQ) commissioned RSE USA, a consulting firm, to compile all of the relevant information about recycling market development in the United States. The complete report can be found here: https://www.oregon.gov/deq/FilterDocs/recMarketDevReport.pdf

Chapter Three: Research Methods

Our research methods, chosen with input from Ecology and the University of Washington Evans School faculty, consist of three approaches—review of the relevant literature, case studies, and semi-structured interviews with industry professionals.

3.1 Research Questions

Our research was guided by the following question: What are the most effective approaches that the Washington Recycling Development Center can take to reduce overall waste and increase recycling rates in response to changing markets and the recent China's National Sword policy? In order to answer this question, we focused on the following four sub-questions:

1. What are the staffing needs, organizational objectives, and tasks for the proposed Recycling Development Center?
2. What recoverable materials do current markets demand?
3. What recoverable materials and recycling processes are the most environmentally and economically beneficial?
4. What are potential regional partnership and public-private partnership models that the Recycling Development Center can implement around secondary recycling market development?

To answer the research questions, we focused on reviewing relevant literature—academic literature, policy briefs, and other reports. We also conducted exploratory case studies of 11 other approaches and semi-structured interviews of 31 industry professionals.

3.2 Qualitative Analysis of Data Collected

We chose to seek answers through qualitative, rather than quantitative, analysis because the stories and insights can provide a more comprehensive understanding and context through which to understand a future Recycling Development Center.[43] We also decided to forego a robust quantitative analysis because this research field lacks strong data, resulting in an inability to be statistically significant in our conclusions.

We used exploratory case studies to analyze other approaches including regional partnerships, public private partnerships, and other recycling development centers—both past and present.[44]

Our goal was to understand successes, failures, and how this information might be applied to a new Recycling Development Center in Washington.

We also conducted semi-structured interviews with 31 government representatives, recycling and waste industry professionals, recyclable materials manufacturers, and recycling coalition and non-profit industry experts. We began with a list of stakeholders provided by our project partners at Ecology and snowball-sampled[45] outward until data saturation occurred.[46] Interviews were guided by a central interview protocol with sub-questions for different sectors.

3.3 Criteria for Evaluating Recommendations

After collecting and analyzing the data, we established the following criteria for evaluating recommendations:

1) *Effectiveness* – How well does the recommendation advance the mission of the Center?

    a) *Environmental Effectiveness* – What are the environmental impacts of implementing this recommendation?

    b) *Market Impacts* – How well does this recommendation solve the market impacts of China's National Sword policy?

2) *Cost* – How much will the recommendation cost to implement?

3) *Institutional Feasibility* – Is the recommendation feasible under both existing law and staffing levels?

4) *Distributional Equity* – What are the distributional outcomes of implementing the recommendations? Will it affect certain populations in Washington more than others?

We used these criteria to evaluate the recommendations that we discovered through interviews or case studies. Political feasibility is typically an important criterion for evaluating recommendations in a policy analysis framework. We chose not to include this in our list, however, because we felt that the Ecology staff who are implementing the Recycling Development Center would be better equipped to judge the delicate political feasibility and would have a more nuanced understanding of the current Washington State political landscape.

3.4 Methods for Creating Work Plan

The work plans break down the recommendations from *Section 5.1* into tasks by staff member. It also outlines which tasks should be overseen by consultants. We have incorporated functions

required of the Center by HB 1543; the Center's staff roles and general duties were adopted from its fiscal note, and expanded or shifted slightly when aligned with other responsibilities or projects. The work plans' activities, assigned tasks, and workloads were also informed by the organizational structure section of the case studies in *Chapter Four* and by interviews with industry leaders.

Chapter Four: Findings

This chapter outlines our findings from two major sources: case studies and industry interviews. In *Section 4.1*, we include findings from 11 case studies—three on government programs, three on recycling development councils, and five on recycling partnerships. In *Section 4.2*, we provide initial findings from our interviews with nonprofit, private, and public industry experts focusing on key market materials and the potential role of the Recycling Development Center. For an expanded case study overview, please refer to *Appendix 2*.

4.1 Case Studies

For a deeper understanding of market development models, we conducted case studies of the Clean Washington Center—the former Washington-based organization that sought to develop secondary markets for recycling—as well as recycling development councils and public-private partnerships. The following case studies inform our recommendations for Washington's new Recycling Development Center. Moreover, an organizational management study, embedded in the study of recycling development councils and recycling partnerships, will provide examples of staffing, funding structures, and programs that the Center could replicate.

4.1.1 Government Program: Washington - The Clean Washington Center (Defunct)

Background: When the Washington State Legislature passed a law requiring municipalities to provide curbside recycling to residents, it also tasked the former Washington State Department of Trade and Economic Development to conduct a study on recycling markets. The resulting study led to the creation of the Committee for Recycling Markets, which recommended that the Legislature create an entity focused on establishing markets for recycling.[47] The Legislature passed SB 5591 in 1990, which established the Clean Washington Center (CWC) that same year.[48]

The original bill appropriated $2 million from the Solid Waste Account for the CWC's first year; the Solid Waste Account and the Litter Account each provided half of the second year's funding of $2.1 million. For the following four years, the funding was a mix of state and federal sources.[49] The federal matching grants came from a cooperative venture with the National Recycling Coalition, called the Recycling Technology Assistance Partnership or ReTAP.

The primary goal of the CWC was to make the use of recycled materials cost-competitive with the use of virgin materials and to encourage the substitution of these recycled materials for

their virgin counterparts.[50] The CWC worked with private businesses, the public, all levels of governments, and members of academia to identify the issues facing a recycled material category and work with these parties to mitigate any barriers and improve the likelihood that recycled materials get reused as feedstock.[51] During its initial research phase, the CWC conducted key informant interviews to identify barriers to using recycled feedstock and to guide informal strategic planning sessions. These sessions were facilitated by CWC's commodity specialists and were meant to uncover the overlap between the supply of a recycled material and the potential demand for that material. From these meetings, commodity specialists put together a plan that outlined the strategies, barriers, and opportunities that could maximize the markets for their material.

The CWC researched the economic forecasts for distinct recycled materials and recycling systems across Washington State, finding that when municipalities collect low-density materials, it lowers the cost effectiveness of the overall system.[52] When researching cost differences between the recycled and virgin materials, it researched five categories of materials: old newspapers, glass containers, high density polyethylene (HDPE) milk jugs, polyethylene terephthalate (PET), and yard waste. This analysis found that the price differences between virgin and recycled materials to be minimal across these categories:

- *Newspaper* – Old newspapers generally led in cost savings for manufacturers, but other factors, such as distance, could dramatically shift these results.
- *Glass* – Due to material loss during transporting, processing, and melting stages, virgin and recycled glass maintained similar costs.
- *HDPE* – Recycled HDPE had a slightly higher cost than virgin HDPE.
- *PET* – The price of recycled PET was substantially cheaper than the price of virgin PET for manufacturing carpet fiber, but was more expensive for manufacturing two-liter pop bottles.
- *Yard Waste* – Yard waste made for a significantly less expensive product, but this product also sold for less than virgin alternatives.[53]

The study explained that virgin materials establish limits to how much a manufacturer would pay for the recycled materials, and it showed that including an accounting method for disposal costs, either by weight or by volume in the overall analysis could improve the economic benefits of using recycling materials.[54] While this strengthens the argument for using recycled materials, it does not further encourage manufacturers to utilize these materials, due to the country's current product stewardship laws, which place waste management costs onto residents and municipalities instead of the manufacturers of products.

An analysis of the CWC showed that it had a positive effect on market demand for recycled commodity markets, and clients overall valued the services that CWC provided, including the

distribution of information about ideas, networking opportunities, technical services, and mediation services, which brought disparate groups together to work through problems.[55]

Despite an overall positive perception of the CWC, a number of industry leaders had major concerns around the operations and achievements of the CWC, including that it could not clearly quantify its achievements; that it favored large or highly visible products; that it focused too much on the private sector and neglected the public sector; that it did not attack the problem enough at the policy level; and that it was too bureaucratic.[56]

The original bill called for the CWC to sunset on June 30, 1997. Many expected the funding for the CWC to be extended, but shortly before the sunset date, the Legislature decided not to continue funding the program. Potential contributing factors to the decision to sunset include: a shift in political power within Washington's Legislature, the growing exports of recycled material to countries like China, opposition from competing industries, and the notion that CWC had already accomplished its mission.

Therefore, in 1997, after six years of being a state-run program, the CWC had to scramble to find a new home. Due to a connection through CWC's leadership, it became a program of a small nonprofit, called the Pacific Northwest Economic Region (PNWER), which supports economic partnerships among Montana, Oregon, Washington, British Columbia, and Alberta.[57]

The wages for the large staff of the CWC financially strained PNWER, and without the State's grants, the CWC struggled to secure matching funds for the federal ReTAP grants. After a loss of both PNWER and CWC leadership, the remaining staff of PNWER was able to negotiate more time with the federal government to finish out the work on CWC's grant; once this period concluded, the CWC stopped operations. From its inception to the time it came under PNWER, CWC worked with 500 companies to facilitate the use of recycled materials in the manufacturer process and is credited with creating 14,000 jobs. [58]

Lessons and Recommendations:

- Keep the mission targeted and focus on high-priority materials.
- When working with industries to find the barriers and opportunities, speak with staff that oversee day-to-day operations and understand the company's manufacturing process on an operational level (i.e. general managers).
- Develop strong relationships with businesses. When working with this private companies on market development, encourage them to consider industry-level solutions and opportunities as well as their own business interests.
- Create a place for stakeholders to share knowledge and uncover processes or technologies to improve recyclability rates.

Organizational Structure: The CWC was broken down into functional areas, each with a specific set of objectives to improve recycling:

- *Business Assistance program* – Provided technical assistance to businesses through an in-house expert for each material category.
- *Technology ReTAP program* – Offered engineering services and technical information to incorporate new technologies that would improve recycling rates of specific materials. The program tested products with recycled content, evaluated equipment and recovered materials, and analyzed the recycling process.[59]
- *Policy and Research program* – Informed policymakers on the barriers and infrastructure needs of recycling markets.
- *Marketing program* – Introduced and promoted new products to the marketplace to increase the use of recycled materials in the manufacturing sector.
- *Management Support program* – Supported CWC through administrative services.[60]

The CWC had 24 full-time employees: three employees in the Office of the Director, five in Business Assistance, eight in Technology ReTAP, one in Policy and Research, four in Marketing, and three in Management Support.[61] Before moving to PNWER, the CWC was a part of the Department of Trade and Economic Development. Since it did not work closely with Ecology, it often duplicated Ecology's recycling efforts and studies.[62]

4.1.2 Government Program: California - CalRecycle

Background: Known as CalRecycle, California's Department of Resources Recycling and Recovery leads the state toward its goal of a 75 percent recycling rate by 2020. CalRecycle's Materials Management and Local Assistance Division offers financial and technical assistance to businesses and manufacturers, which advance the use of recycled content materials as feedstock. It offers targeted grants for the recycling of specific products, such as tires, and loans for businesses and manufacturers that meet certain criteria or targets. Using funds from the state's Cap-and-Trade program through California Climate Investments, CalRecycle's Recycled Fiber, Plastic, and Glass Grant Program awarded more than $11 million to five private companies that developed projects focused on boosting the recycling rates of #2, 4, and 5 plastics in the state, as well as one project to recycle windshield glass.[63]

To further encourage secondary market development in California, CalRecycle offers a number of other financial assistance opportunities targeted toward companies which process recycled materials or manufacture products with recycled content. For the 2018 to 2019 year, the Recycling Market Development Revolving Loan Program has had $3,565,000 of available funds with a four percent interest rate; these funds are available to companies in designated recycling zones. As of mid-January 2019, its Greenhouse Gas Reduction Loan Program had

$3,250,000, also with a four percent interest rate. To qualify for this loan, an applicant must prove that it can reduce greenhouse gas emissions through its operations. The loan program partners with Governor's Office of Business and Economic Development (GO-Biz) to provide facility siting, permitting assistance, and technical support.[64]

Lessons and Recommendations:

- Build and maintain a database of private companies, packaging manufacturers, and trade councils. Solicit their feedback through workshops and presentations.
- Align the recycling market development programs with other environmental and financial programs and initiatives of the state to reduce internal competition for resources.
- Permitting facilities can take a long time, so allow time for this process when developing goals and targets for the Recycling Development Center.

Organizational Structure: CalRecycle's Materials Management and Local Assistance Division has staff teams with differing focus areas, including business assistance programs, financial loans, grants, and technical assistance. It also partners with the Governor's Office of Business and Economic Development (GO-Biz) to assist in business development.

4.1.3 Government Program: Colorado - NextCycle

Background: For many years, Colorado has offered grants to companies for market development through funds directed from tipping fees. As a response to the China National Sword, Colorado Department of Public Health & Environment expanded its market development efforts and, in collaboration with consultant RRS, developed a virtual business incubator program for companies looking to establish or expand the use of any recycled material in Colorado.

The first cohort of nine companies was chosen in the beginning of 2019. The cohort included local startup companies and firms from outside of Colorado interested in establishing a location within the state. The program offers a grant of $5,000 per company to be used as seed funding, as well as technical assistance, business development mentoring, and data sharing. The participating cohort members give feedback to each other's business plans and projects at a one-day, in-person accelerator. Additionally, each cohort member has the opportunity to pitch its idea and gain additional support from other companies or investors at the Summit for Recycling, the state's annual recycling conference. After the conference,

cohort members receive final feedback from NextCycle, and the cycle of the program concludes; participants can then apply for the established recycling grants.[65]

Lessons and Recommendations:

- Provide a platform for companies to share business and technical knowledge regarding recycling.
- Many individuals starting companies to improve recycling outcomes are motivated to solve an environmental problem; for many of these individuals, the business model is not what drove them to start the company. Offer guidance in the development of a business model for participating companies.
- A business incubator model allows time for a company to better develop a business plan and solicit feedback from stakeholders and advisors before seeking a larger grant from the program.

Organizational Structure: The Department of Public Health & Environment has a Recycling Grants Administrator that acts as a liaison to the consultant company that works on the operations of the program. Three primary consultants from RRS work on NextCycle, while other subject matter experts from within the company support the projects.

4.1.4 Recycling Development Council: Southeast Recycling Development Council

Background: The Southeast Recycling Development Council (SERDC) is an 11-state organization established in 2006. The SERDC's mission is to: 1) increase collection and recovery of quality recyclable material; 2) foster economic development via the recycling industry; and 3) create a greater awareness of the recycling industry's impact in the southeast. SERDC fosters partnerships through direct participation, events, and grants; conducts outreach and public education; and recommends best practices by offering frameworks, such as the Pay As You Throw (PAYT) strategy.[66]

Lessons and Recommendations:

- Provide financial assistance through grant programs, sponsored by partnerships between different sectors. SERDC offers a recycling infrastructure grant program, supported by the Recycling Partnership and the Coca Cola Foundation, to help fund recycling infrastructure, such as recycling carts and material recovery facility upgrades.

- Partner with and create regional recycling partnerships. SERDC partnered with Alabama Recycling Partnership to provide economic and policy analysis on recycling practices in Alabama. SERDC and its partners convened to create SERDC 120, a 120-day and a 120-member workgroup. This group established the Recycling Partnership, a public-private partnership, with a goal to increase the recovery of recyclables in the region (See *Section 4.2.8* for more information on the Recycling Partnership).
- Publish monthly newsletters to share current news and information on upcoming events to members.
- Host summits, special focus events, forums, workshops, and webinars. SERDC hosts a biennial summit in different cities throughout the Southeast.
- Offer educational resources, such as maps, economic reports, market directories, and waste exchange information.

Organizational Structure: SERDC, a 501(c)3 non-profit organization consists of a board comprised of an executive committee, a general board, an ex officio committee, and two staff members. The executive committee includes a Chair, First Vice Chair, Second Vice Chair, Treasurer, and Secretary. The general board consists of 12 members from the private and nonprofit sectors, and the ex officio committee consists of a member each from the Alabama Department of Environmental Management, the EPA Region 4, Waste Management, and KW Plastics Recycle. The general staff includes an Executive Director and Director of Outreach and Member Services. SERDC is supported by membership and sponsor support, state agency partnerships and grants, and EPA grants.

4.1.5 Recycling Development Council: Northeast Recycling Council

Background: The Northeast Recycling Council (NERC) is a 30-year-old organization that serves 11 states in the Northeast region of the United States. NERC's main services are: research, technical assistance, demonstration projects, and education.[68] NERC works on projects focusing on toxics in packaging, electronics recycling, glass, and organics management. In addition to the aforementioned priorities, NERC's board listed plastics #3 through #7 and recycling market development support as its priorities for the fiscal year of 2019.[69] Notably, from its most recent annual report, NERC implemented a joint strategic action plan with the Northeast Waste Management Officials Association. The plan included joint webinars, a new regional Recycling Markets Development Workgroup, and projects with the West Coast Climate Forum. Through its website, NERC provides resources including individual member state information, a search feature for research purposes, and a blog that

features guest writers exemplifying best sustainable materials management practices. NERC hosts two annual conferences in spring and fall.[67]

Lessons and Recommendations:

- Provide consultative services. NERC provides services in recycling business development, research and assessment, recycling market development, materials management program development, educational materials, training, workshops, webinars, technical assistance, and multi-stakeholder dialogue facilitation.
- Look beyond the state and local levels to create an impact. NERC administers two national programs—the Toxics in Packaging Clearinghouse and the Electronics Recycling Coordination Clearinghouse programs. The council assists programs through financial management, project management, implementation, grant writing, membership services, and public outreach.
- Form committees within the council focusing on priorities identified by the board. For instance, NERC has a 17-member glass committee, established by the board and aimed at understanding the glass value chain and gaps in the region.
- Define clear staff roles for the organization. NERC, for instance, defines the distinctive roles of the executive committee, board members, advisory board members, and staff.
- Require the board to identify the organization's priorities in terms of materials, practices, and policies for each annual report.

Organizational Structure: NERC has five staff members, including an Executive Director, Assistant Director, Special Projects Manager, Office Manager, and Program Manager. An executive committee consists of a President, Vice President, Treasurer, and Executive Director. NERC currently has 11 board members, one from each of the member states. The Executive Committee has general oversight of the organization, while the board identifies NERC's goals and policies. The organization has advisory members from the public and private sectors that participate, without voting rights, in NERC discussions. NERC's operational activities are funded by grants, state and advisory membership dues, donations, conference and workshop registrations, exhibitor fees, sponsorships, and cash reserves. Nearly half of NERC's revenues comes from grants and projects, while 39 percent comes from membership dues.

4.1.6 Recycling Development Council: Recycling Council of British Columbia, Canada

Background: The Recycling Council of British Columbia (RCBC), the oldest recycling council in Canada, serves mainly as an information center for the province's extended producer responsibility programs, curbside recycling programs, and other waste reduction and reuse programs. RCBC manages online and app-based public education tools, such as the RCBC Hotline and a RCBC Recyclepedia, which answers residents' questions on recyclable products in their geographic area. Additionally, the RCBC Materials Exchange promotes material reuse through a network of free-to-use sites. The council also facilitates policy development, holds annual conferences and special events, promotes partnerships, distributes publications, and provides contract services for a fee. The contracting fee ensures financially security. RCBC created a five-year strategic plan to set its goals and correlated action steps. In 2019, RCBC held its 45th Conference on Circular Economy, where more than 250 industry professionals convened to share best practices and innovations.[70]

Lessons and Recommendations:

- Develop strong educational services, such as mobile recycling encyclopedia and hotline, to readily answer the community's questions. Another example is RCBC's Road to Zero Waste! program that provides teachers with resources for zero waste lessons through interactive in-class presentations, activities, and a student handbook.
- Hold annual conferences and trade shows to encourage discussions and share innovations and new programs among public, private, and non-profit industry professionals. At RCBC's annual conference, the council also presents awards to those that have made a notable contribution to RCBC's zero waste mission.
- Create publications for educational value and to clarify the council's strategic plans and policy positions. Publish fact sheets on demolition materials, zero waste case studies, and toxic toolkits. Publish strategic plans, municipal solid waste tracking reports, annual reports, and background papers.
- Provide information on external private and government programs, such as curbside programs, extended producer responsibility programs, and retailer take-back programs.

Organizational Structure: RCBC is a registered charitable organization run by nine staff members and a Board of Directors.[71] The Board consists of four industry representatives, three government representatives, three non-profit representatives, and two at-large representatives. The directors are elected for two-year terms. The staff roles include: CEO, Finance Director, Information Services Manager, Member Services Manager, Information Services Assistant, Information Officer/ Materials Exchange Officer, Information Officer/

Education Outreach Officer, and Hotline Information Officer. RCBC holds annual meetings, where each member has one vote, and board meetings, where each director has one vote. Otherwise, RCBC holds special meetings if requested by 10 percent of the voting members. According to its 2015–2016 annual report, RCBC earns the bulk of its revenues from service agreements, conference admission profits, and the British Columbia Ministry of Environment.[72] The remainder of revenues are from memberships, sponsorships, and project revenue.

4.1.7 Recycling Partnership: Chicago Board of Trade Recyclables Exchange (Defunct)

Background: In operation between 1995 and 1999, the Recyclables Exchange offered an online forum to buy and sell recovered materials.[73] Initially, participants paid a $1,000 annual membership fee, which dropped to $10 in the fall of 1996 when the exchange transitioned from an electronic bulletin board accessed through a computer modem to the internet.

The Exchange sought to reduce marketplace inefficiencies, better match buyers and sellers, improve information on recovered materials' prices, and reduce price volatility and risk. Surveyed members believed that the Exchange made markets more efficient and improved consistency for material specifications, but that it lacked a commitment from larger buyers and sellers, and that it couldn't break the industry away from personal relationship–based trading. While membership continued to grow up until its closure—reaching a high of 569 members—the number of trading transactions and the number of material listings remained too low to justify the continued operation of the Exchange.

Lessons and Recommendations:

- Provide networking opportunities and a place for an open dialogue between buyers and sellers of recycled materials.
- Offer real-time information on pricing and market trends for recycled materials reduces risks for both buyers and sellers.
- Uncertainties regarding quality and contamination levels create difficulties for the online trading of recycled materials.

Organizational Structure: The Exchange was run by the Chicago Board of Trade, a futures and options exchange, now known as the CME Group Inc. This service was developed in collaboration with the National Recycling Coalition's Recycling Advisory Council, the CWC,

the New York State Office of Recycling Market Development , and the U.S. EPA's Office of Solid Waste.

4.1.8 Recycling Partnerships: The Recycling Partnership

Background: The Recycling Partnership is a regional public-private partnership between SERDC and Curbside Value Partnership.[74] The partnership was founded in 2014 to improve recycling infrastructure and outreach in the southeast region of the country. The concept of the partnership materialized at a convention of SERDC and its 120 partners, who collectively agreed on the value of public-private partnerships financed by strategic, one-time, leveraged investments. They "identified cities favorable for partnership, designed a prescription of work and designated timelines, budgets, and potential partnerships essential for that work's success." The SERDC 120 group also signed a memorandum of understanding, which encouraged interested companies and associations to pool funds and increase the region's recycling rates. The Recycling Partnership supports the recycling industry through 1) grants, technical assistance and tools; 2) research, measurement, and best practices; 3) partnerships; and 4) scale (coverage). Their main community programs focus on providing carts for recycling, reducing contamination, and engaging residents to recycle properly.

Lessons and Recommendations:

- Include scale as a criterion for actions implemented by the Recycling Development Center.
- Define measures for scale and success. The Partnership measures growth through several indicators, including number of communities supported, carts placed, households reached, dollars invested in recycling infrastructure, pounds of recyclables diverted, and metric tons of greenhouse gases and carbon dioxide mitigated. [75]
- Leverage companies' interest in improving corporate sustainability goals by investing in recycling initiatives in their communities. The Partnership's 40-plus funding partners include 1) corporations, such as Amazon, Coca Cola, Exxon Mobil, Target; 2) the public sector, including the U.S. EPA; and 3) national recycling development councils, such as the Carton Council.
- Provide education campaign starter kits for social media, blogs, campaign materials, and a greenhouse gas and water savings calculator tool. Most notably, The Partnership provides a MRF Tracking Form that facilitates feedback from MRFs to the community through extant communication channels.

- Offer targeted grants. The Partnership offers coastal community recycling and cart grants.

Organizational Structure: The Partnership is funded by more than 40 funding partners and run by 33 staff members with the following roles: CEO, Strategic Partnership Lead, Director of Marketing, Senior Director of Industry Collaboration, Vice President of Public Affairs, Data Architect, Community Program Coordinator, Director of Community Programs (2), Executive Director of Circular Economy Accelerator, Vice President of Industry Collaboration, Digital & Design Manager, Community Program Liaison, Community Liaison, Vice President of Strategic Communications, Director of Innovation, Community Program Coordinator, Funding Partner Liaison, Chief Community Strategy Officer, VP of Community Programs, COO, Senior Director of Strategy and Research, Director of People Ops, Senior Director of Corporate Partnerships, Senior Director of Program Design, Project Assistant, Director of Corporate Engagement, Logistics Coordinator, Recycling Technical Advisor, Director of Grants & Community Development, Senior Director of Strategic Projects, Conference and Workshop Manager, Advisor to the CEO, and Director of Community Programs.

4.1.9 Recycling Partnership: Beyond 34

Background: Beyond 34 is a pilot project launched by the U.S. Chamber of Commerce Foundation (UCCF) to study public-private partnership (P3) best practices to increase the 2014 national recycling rate of 34 percent, as well as to promote a circular economy. Until 2019, the Foundation has been operating its pilot program in Orlando, Florida, based on its average area recycling rates, strong P3 engagement, and commitment to sustainability. The UCCF pilot project aims to map the materials "wasteshed" and perform recycling best practices gap analysis to identify future actions.[76]

The project consists of three phases:

1. Engage local stakeholders, including manufacturers, haulers, and retailers;
2. Identify the most effective approaches and projects to increase the recycling rate of 34 percent; and
3. Begin implementing such projects.

In February 2019, the U.S. Chamber of Commerce Foundation announced its intention to expand the project to a second region based on the success of the Orlando pilot project.[77]

Lessons and Recommendations:

- Organize a recycling champions' network and develop a regional plan for recycling.
- Leverage technology to recover more commodity recyclables.
- Develop supportive waste policies and incentives.
- Engage public and private stakeholders through a collaborative communications campaign.

Organizational Structures: The partnership's Project Founders include the UCCF, City of Orlando, Orange County, FL, and the Orlando Regional Chamber of Commerce. The Founders collaborate with additional partners in the Orlando area, such as leading brands, manufacturers, retailers, industrial service providers, local school districts, and theme parks. The Project Founders provide partners with information on "determining how they could build on existing recycling programs, funding mechanisms, and business models to finance the systems," and recycling best practices. Meanwhile, the other partners provided the Project Founders with commercial and residential recycling data for the material mapping and with communication contacts to conduct outreach.

4.1.10 Recycling Partnership: Alabama Recycling Partnership

Background: The Alabama Recycling Partnership, established in 2015, serves to analyze recycling management best practices, the economic impact of the state's recycling industry, the impact of Alabama Department of Environmental Management's grant program on material recovery, and a hub-and-spoke model design for the processing of materials. While Alabama was making good progress towards its statutory waste reduction goal of 25 percent, the State of Alabama wished to increase its low material recovery rates. Given the abundance of end-use markets in the region, research concluded that the problem lay in Alabama's fragmented processing capacity and recommended that the state create a more unified regional recovery system using a hubs and spokes model. The model is based on the concept of creating transportation corridors through transfer stations connecting smaller localities to the hub of MRFs central to the processing of all the recyclable materials.[78]

Lessons and Recommendations:

- Complete a research report, led by the Recycling Development Center and sponsored by the partners and members of recycling development councils. The report completed by the Alabama Recycling Partnership includes a waste characterization study, economic analysis of recycling in the state, assessment of the state of recycling in

Alabama, and a final list of recommendations. The following are pertinent best practices extracted verbatim from Alabama Recycling Partnership and SERDC's Report: [79]

- Encourage and incentivize local governments to adopt a common suite of materials in their recycling program. The state should also develop a toolkit of consistent material descriptions using available industry sources, and disseminate the toolkit for use in local recycling promotional and educational materials.
- Develop a standardized recycling education and outreach program that establishes a theme and a "brand" for recycling in the state. Provide specific tools to communities to enable them to adopt the brand, and adapt the theme to their own situations.
- Improve the statewide data reporting system and ensure that it covers all entities that manage materials, including collectors and markets. The state should convene relevant stakeholders in a structured design process to gather their input and ensure cooperation and understanding.

Organizational Structure: The partnership consists of KW Plastics, Proctor and Gamble, Carton Council, the Alabama Department of Environmental Management, International Paper, and five local governments. The SERDC works closely with the partnership, at the request of the State of Alabama.

4.1.11 Recycling Partnership: Arizona State University RISN Incubator

Background: In 2013, the City of Phoenix's Public Works Department launched a waste diversion and sustainability initiative known as Reimagine Phoenix and set a goal of diverting 40 percent of trash from landfills by 2020. The City aimed to accomplish this diversion goal in three ways: enhance current city solid waste programs, partner with industry and community leaders to find viable solutions to waste diversion issues and concerns, and increase communication with and education of residents and businesses about diversion and sustainability efforts.

As part of the Reimagine Phoenix Initiative, the City of Phoenix partnered with Arizona State University (ASU) in 2014 to launch the Resource Innovation and Solutions Network (RISN) Incubator program at the university. The program operates as an accelerator for small waste-to-product businesses. The overall goal of the program is to promote a circular economy in the Phoenix area. As of December 2018, the program has raised $2.95 million to assist 13 ventures in the first two cohorts. In April 2019, the program welcomed its third

cohort of businesses. Over the course of the incubator program, each cohort of businesses has access to:

- ASU faculty, City of Phoenix staff, and other local experts and mentors on a variety of topics
- A series of technical development workshops to help them grow and scale their businesses
- Feedstocks from Phoenix's waste transfer station
- A process for continuous evaluation
- Pre-qualification for funding opportunities with introductions to financiers

The program allows the cohort to access waste from the City of Phoenix, thus diverting recyclables or compostables from the landfill stream. The City of Phoenix has prioritized available material feedstocks and estimated the available tonnage for each material:

- Priority 1: Plastics #3 through #7; 420 annual tons available.
- Priority 2: MRF residuals; 40,000 tons available, including non-distinct fine particles, textiles, organic materials, hard plastics, and plastic film.
- Priority 3-7: Batteries, carpeting and carpet foam, broken furniture, soiled mattresses, and other materials.[80]

The partnership between ASU and the City also created an 80-acre physical space called the Resource Innovation Campus (RIC), which houses the technology incubator program.[81] The RIC has five main components:

- *Waste transfer station* – A traditional transfer station is intentionally located near the RIC. As the RISN Incubator attracts new manufacturing processes and conversion technologies that use trash as resources, the transfer station will divert more volume away from the landfill and into the city's circular economy.
- *Materials recovery facility (MRF)* – A traditional MRF that could expand its role to allow Phoenix residents to recycle additional items. Currently, the MRF sorts glass, paper, metal, cardboard and plastic.
- *Composting facility* – A new facility that is expected to divert some of the 400 million pounds of compostable materials currently sent to the landfill each year. The facility began operation in 2017 with a current capacity of 55,000 tons of organic material per year.
- *Land leases* – Approximately 40 acres of property that are made available for lease by innovators and manufacturers with market-ready technologies and manufacturing

processes that use trash to create new products. A competitive process determines how the land will be developed.

- *RISN Headquarters and Technology Solutions Incubator* – The business incubator provides office space, business development workshops, support services, technical services, and access to possible funding resources for innovators.[82]

Lessons and Recommendations:

- Consider an intergovernmental partnership between Ecology and either municipalities or state universities to administer the program.
- Differentiate between an incubator and accelerator. While RISN was called an incubator, it in reality acted as an accelerator—providing space, training, and resources to small, established businesses (accelerator) rather than capital for startup ventures (incubator).
- Develop a national Request for Proposals (RFP) process to attract applications from a broad base of local and national businesses. The initial RFP for the RISN program attracted 118 proposals.
- Make the municipal waste stream accessible to ventures; distribute the 2016 Waste Characterization Study as a part of the RFP process and program.
- Recruit and select a diverse group of businesses that address both current waste needs in the state and future demand, such as around flexible packaging or cartons.
- Research the feasibility of a physical space to house an accelerator program and associated ventures. The accessibility of space and materials in one central location has been a boon for the RISN program.

Organizational Structure: The RISN program is managed and operated by Sustainability Solutions Services, a program within the Walton Sustainability Initiatives at ASU. The City of Phoenix provides funding and infrastructure for the program. The City of Phoenix owns the RIC land and manages the leases to cohort members.

4.2 Interview Findings

Our interviews provide important insights on materials and industry concerns from recycling professionals both within Washington State and nationally. *Section 4.3.1 Materials* identifies the types of materials that interviewees suggested the Recycling Development Center should focus on, and *Section 4.3.2 Recycling Development Center* suggests big picture responsibilities that the

Center could assume. For the list of interviewees, please refer to *Appendix 1*. See *Appendix 5* for our Interview Findings Matrix.

4.2.1 Materials

Interviewees indicated that the most important materials for the Center to address are mixed paper and plastics, particularly #3 through #7.

- *Mixed Paper* – Mixed paper was the topic mentioned most frequently throughout the interviews. Interviewees identified sorting and processing costs for mixed paper as the greatest barrier to the recycling of the material. Unlike China, the Pacific Northwest region lacks an end-use market for mixed paper feedstock, making it less financially attractive to process. Interviewees stated that, in response to the China's National Sword restrictions on contaminated materials, the Center should facilitate the siting of mixed paper re-sorting operations, as well as support or facilitate the establishment or update of paper mills to handle commingled, recycled paper. Interviewees suggested supporting the use of recycled mixed paper in green building products as it has the potential to displace high volume and high performance virgin materials. Products could include drywall or flexible packaging inputs as fibers. However, virgin paper stock is currently very inexpensive, creating a competitive market barrier for recycled materials in construction and building practices.

- *Plastics* – Interviewees indicated that plastics #3 through #7 are the most problematic materials to recycle. EFS Plastics, Inc. currently operates MRFs on the east coast of the United States. that process and clean contaminated plastics, which are then turned into fuel, pellets, and flakes. The company plans to open a West Coast MRF. To confront the challenges around plastics, interviewees suggested that Recycling Development Center facilitate the siting of specific mixed plastic recycling processors in the Northwest region, and that the Center focus on facilitating a robust collection system for plastic. Oregon Department of Environmental Quality (DEQ) is currently researching the development of a PRF and a processing center focused on handling containers. If Oregon decides to pursue one or both of these options, it could create partnership opportunities across state lines. As discussed above, interviewees also cited the reuse of recycled plastics in green building products as an important market development opportunity.

- *Other Materials* – Glass, aluminum, and organic materials were conveyed as secondary concerns for the region. Interviewees mentioned glass as a problematic recyclable material because of its heavy and fragile characteristics that make transportation difficult. One interviewee stated that the production of glass in three colors further complicates the proper recycling of the material by individuals. Another interviewee proposed that glass be separated from other recyclable materials. Yet another interviewee noted the success of bottle bills in neighboring states as a model for Washington. Several interviewees emphasized the importance of organic materials, which was one of the major areas of

focus for the Clean Washington Center. Fiber and metal markets remain relatively strong, but an interviewee recommended that the Center focus on current markets before establishing or identifying new ones.

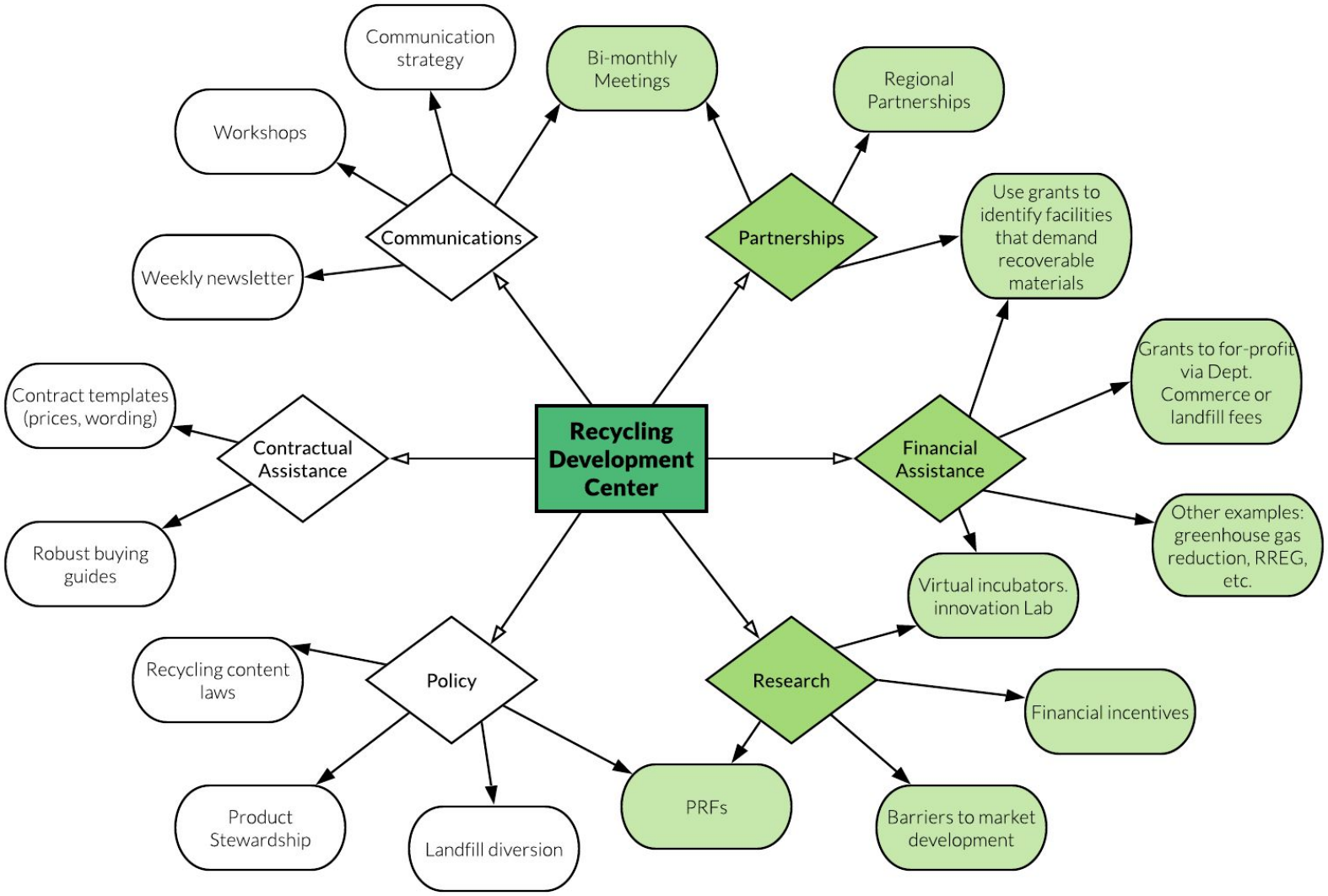
4.2.2 Recycling Development Center

When asked about their expectations for the Recycling Development Center, interviewees expressed interest in six general areas of focus:

1. Partnerships;
2. Financial Assistance;
3. Research;
4. Policy;
5. Contractual Assistance; and
6. Communications.

Figure 5 below, shows a chart of focus areas for the Recycling Development Center. The chart illustrates the six focus areas in the diamonds, with more detailed suggestions in the ovals. Although the focus areas have overlapping, attributable activities and projects, interviewees deemed research, financial assistance, and partnership building (highlighted green in the chart) to be the top priorities.

Figure 5: Focus Areas Chart



1. *Partnerships* – Though interviewees did not explicitly advocate partnerships as one of the Center's initiatives, interviews with other partnerships as well as individual case studies demonstrate how partnerships facilitate the goals of all the other focus areas. Interviewees suggested a partnership between Washington, Oregon, and British Columbia, Canada, which could foster communication, through conferences, sharing of knowledge and tools (including contractual templates), collective research, and the provision of educational campaign toolkits. By serving as an information and communication hub, the Center could support research, policy development, and contractual assistance. Further, partners including the Center could work collaboratively to efficiently disperse financial assistance to appropriate parties. As demonstrated through the case studies, potential partners could include regional or national businesses, recycling development councils, regional government programs, tribal representatives, and the public sector. Most importantly, a regional partnership would not only foster collaboration between states, but also encourage collaboration between diverse actors within each state.

2. *Financial Assistance* – While HB 1543 offers funding to public sector entities, it does not create a sustained funding source or program for manufacturers or other relevant private entities interested in processing or using recycled feedstock. What's more, the Washington State Constitution places tight restrictions on financial assistance to private corporations. In *Chapter Two*, several financing options were presented as potential opportunities for the Center's programs. Specifically, the Center could direct funds to an incubator or accelerator program to support market development in the state. Moreover, several interviewees suggested that the Center could direct funds through grants to public entities to technologically update processing facilities and to support manufacturers interested in using recycled feedstock.

   Organizations we interviewed that provided grants indicated that it helps locate markets and facilities that have the potential to demand recoverable materials. California's CalRecycle serves as an exemplary model of a financial assistance program; revenue from tip fee services for landfill use are dispersed as greenhouse gas reduction loans to waste recycling companies. Colorado's NextCycle offers an alternative model to large loans and grants by providing seed funding to businesses looking to grow their business model.

3. *Research* – While this report provides initial research into the state of the recycling market in Washington, our interviews suggest the importance ongoing investigation into the following topics: financial incentives, barriers to market development, siting a plastic recovery facility in the state, existing solid waste policies, and the feasibility of an innovation lab to support the establishment of businesses or assist technological development.

4. *Policy* – Interviewees suggested writing legislation on mandatory recycling content, plastic recovery facilities, landfill diversion, and product stewardship especially regarding plastic and cardboard packaging.

5. *Contractual Assistance* – Two interviewees requested robust buying guides and contractual templates for pricing and wording; however, some interviewees denied the need for contractual assistance and disapproved the idea of the Center focusing its resources in this area.

6. *Communication Support* –

    a. *Within the recycling industry*: Several case studies and interviewees noted the importance of matching buyers and sellers of recycled materials to develop secondary markets through in-person meetings, networking events, conferences, and online databases and forums. Several interviewees mentioned the importance of building sectoral or materials-based collaboratives to expand markets or improve processes or technologies.

    b. *To the public*: Several interviewees felt strongly about the need for an improved communication strategy to educate the public on contamination levels, proper recycling, and waste reduction practices. Current educational campaigns frame recycling as an environmental movement rather than economic goods. As a result, some interviewees believed the public does not fully understand that the collection, sorting, and processing of recyclable materials costs money. Some interviewees felt that the Center could focus on communicating the economic costs of recycling and use of feedstock materials, as well as the practice of waste reduction.

Chapter Five: Recommendations and Workplan

5.1 Recommendations

As a direct result of our findings from the literature review, stakeholder interviews, and case studies, we recommend that the Washington Recycling Development Center focus its efforts on three areas: partnership building, market development assistance, and research. Our recommendations are consistent with current Washington State legal code and were designed within the parameters of the Legislative bill.

The Washington Recycling Development Center should:

1) Develop a regional partnership to develop markets for recycled materials
2) Create an accelerator program with the option to expand this program to include a business incubator in the long term
3) Research strategies to attract manufacturing facilities using recycled feedstocks
4) Develop two public databases to better connect industry stakeholders
5) Research infrastructure needs to determine current gaps

Figure 6: Policy Matrix illustrates the strengths and weaknesses of each recommendation according to four criteria: market impacts, cost, institutional feasibility, and distributional equity. We have scored the recommendations using a low, medium, high score for each criterion. The cells in dark green signify the most ideal rankings within that criterion. The lighter shades of green signify a less optimal ranking. In the following sections, we further explain each recommendation and our rationale for its score on the policy matrix.

Criteria	Determine Regional Partnership Model	Create Incubator	Create Accelerator	Research strategies to attract manufacturing facilities using recycled feedstocks	Develop Database	Research Infrastructure Needs
Market Impacts	**High** Partnerships promote education and the sharing of technology and knowledge.	**Medium [Low (Short Term), High (Long Term)]** Incubators encourage the development of new technology, business models, and processes, but it takes time for companies to establish themselves.	**High** Accelerators encourage existing industry leaders in their attempts to create/assist markets.	**High** Improving manufacturing competitiveness would increase the adoption of technologies and processes to increase recyclability rates.	**Medium** A shared database would improve transparency on market demand and supply.	**High** ECY would keep up-to-date on market trends and potentially adopt a proactive approach.
Cost	**Medium** Costs will be transferred to sponsors or shared across partners.	**High** The state will provide seed money.	**High** The state will provide facility siting and business model development assistance and potential financial incentives to startup firms.	**High** The research itself may not incur as high of costs, but the provision of financial incentives would.	**Low** Despite the initial developing costs, the overall maintenance costs should be low.	**Medium** This would require costs of the research team and any equipment they might need.
Institutional Feasibility	**High** Potential partners expressed interest and already have partnership experience.	**Medium** This depends on partnerships and financial assistance options.	**Medium** This depends on partnerships and financial incentive options.	**Medium** Any additional financial model would need to be appropriated by the legislature.	**High** Ecology and Commerce have the capability of making a database.	**High** The staff of the Recycling Development Center can take the lead on this research.
Distributional Equity	**High** Partnerships could input diverse voices.	**Medium** Depends on the technology developed and its capacity to be utilized by other firms or facilities.	**Medium** Depends on the business assisted.	**Medium** This may be limited to the public sector or a small number of eligible projects.	**High** The database will be accessible to all.	**Medium** Depends on the research results but could research needs of the rural regions.

5.1.1 Develop a Regional Partnership

All the partnerships from our case studies had missions focused on the areas of education, financial assistance, and research, as well as additional scope depending on the partnership. The partnership model, including the partners involved and the organizational structure, define the scope of the partnership's works. In deciding a partnership model for the Center to pursue, the Department of Ecology should consider its financial and staffing resources that can shape the partnership's mission and scope. Additionally, the legal structure of the partnership model will determine cost allocations and revenue sources for the partnership. For instance, many partnerships studied are registered 501(c) non-profit organizations that receive the majority of their funding from sponsors, conference admission tickets, and a public agency. Therefore, the Recycling Development Center should determine which model would work best for its resources and objectives. Additionally, we recommend that Ecology engage the equivalent agencies in Oregon and British Columbia as potential partners, as they share some of the regional concerns for identifying recycling markets. Even if Ecology does not end up partnering with these two, British Columbia, in particular, has a lot of partnership experience and knowledge to share.

The case studies and interviews with existing recycling partnerships illustrate the unique benefits they can provide. Partnerships could implement educational campaigns through conferences, social media kits, virtual teaching materials, hotlines, and encyclopedias. These educational campaigns could target the general public or businesses and nonprofits that may be interested in recycling practices. Alternatively, partnerships could offer financial assistance to industries and nonprofits to accelerate the development of recycling business models or to invent technology to resolve market challenges in recycling. Partnerships could also research policies or policy options, programs, best practices, environmental and economic impacts, and market trends.

When establishing a regional partnership, the Recycling Development Center should also assess potential partners and stakeholders within the state. A regional partnership needs to account for a way through which diverse groups could voice their opinions concerning the partnership. For instance, a partnership model with diverse actors, including tribal recycling representatives, on the general board or executive committee of a partnership could foster the inclusion of all stakeholders within the state and ultimately improve the distributional equity of all the partnership's efforts.

As depicted in *Figure 6*, developing a regional partnership results in high market impacts, as it would promote the sharing of technology and industry knowledge. The option requires medium-level costs, in comparison to the other recommendations, and we expect that the costs will be transferred to sponsors or shared across partners. The option has high institutional feasibility, with potential partners having already expressed interest or already having partnership experience. It supports a high level of distributional equity, as the partnership encourages input from diverse stakeholders.

We recommend that the Recycling Development Center:

1) Determine a regional partnership model.
2) Consider British Columbia and Oregon as potential partners.
3) Consider how diverse groups within Washington state will interact with the partnership.
4) Delegate roles for the Center staff to manage the partnership.
5) Maintain constant communication with potential partners to define the partnership vision and mission and establish the organizational structure to reflect them.

5.1.2 Create an Accelerator Program

Of utmost importance for the Recycling Development Center to address is the creation of a robust market for recyclable materials in Washington, including mixed paper, construction materials, traditional plastics #1 and #2, plastics #3 through #7, and more untraditional but booming materials, such as plastic film and cartons. Through our interviews, we heard from both industry and municipalities that financial or resource support is paramount to manufacturers and private entities to support the development of a competitive marketplace in the state. However, as stated in *Sections 2.5* and *4.3.2*, state funding given directly to private entities is quite restrictive.

Therefore, we recommend an alternative, creative solution in which Ecology develops and implements an accelerator program to establish a diverse recycling market through intentional business development support and resources. *Case Study 4.2.11* provides a robust example of a functioning accelerator partnership between the City of Phoenix and Arizona State University. Per our policy matrix, an accelerator program would have high market impacts by encouraging diverse businesses to enter the recycling market in Washington state through a national RFP process. Operational costs such as staffing and program administration may be high, but a pilot partnership with another state government department, or a municipality or region could create additional capacity and lower operational costs for Ecology. Finally, this policy option could be strategically sited near an existing MRF or potential PRF facility (See *Section 5.1.5*) to increase access to feedstock for business ventures and divert feedstock into a circular economy model.

The accelerator model focuses on more developed models and businesses than that of an incubator model, leading to quicker results and more immediate actualized benefits. Because of this timing, we recommend beginning with the accelerator model as a starting point for the Center. Once it is established, the program could expand to include an incubator element, like the one seen in *Case Study 4.2.3*. This would nurture startup businesses from an initial idea to

a fully formed business model, and would add more depth to the accelerator program in the future.

We recommend that the Recycling Development Center:

1) Review the 2016 Waste Characterization Study to prioritize feedstock to be addressed in the accelerator program. Based on our findings, we recommend an emphasis on mixed paper, plastics #1 and #2, and #3 through #7.

2) Research and develop an intergovernmental partnership between Ecology and municipalities or state universities to administer the program. We recommend an initial pilot partnership with opportunity to expand the program statewide upon proven feasibility and success.

3) Research the feasibility of a physical space to house an accelerator program and associated ventures. Consider proximity to a MRF or potential PRF.

4) Develop a national RFP process to attract innovative businesses from a broad base.

5) Recruit and select a diverse group of businesses that address both current waste needs in the state and future demand, such as around flexible packaging or cartons.

5.1.3 Research Strategies to Attract Manufacturing Facilities Using Recycled Feedstocks

The importance of financial assistance was a common theme in both the interviews and the case studies in *Chapter Five*. Understanding the barriers to entry and focusing these funds toward end-use markets were key takeaways. With the restrictions placed on giving financial assistance to private firms in the state, Washington should instead study its relative attractiveness to manufacturing facilities interested in using recycled feedstock and recommend and implement a model to increase its competitiveness and realize the benefits of this research activity. This research could lead to a financing program for projects or an exemption for sales or operational taxes that the Center would need to bring to the Legislature for approval. While the need for legislative action makes these options less feasible institutionally, due to its potential for high market impact, the Center should research and develop other models for financial assistance that it could employ.

We recommend that the Recycling Development Center:

1) Interview manufacturers and recycling processing facilities to understand barriers to entry and funding opportunities for increasing the use of recycled feedstock.

2) Research Washington State's relative attractiveness to manufacturing facilities interested in using recycled feedstock.

3) Finalize and recommend any funding model recommendation to the legislature that would need appropriation.

4) Partner with the Department of Commerce to market the funding opportunities outlined in *Chapter 2* to projects that could meet the eligibility criteria.

5) Partner with the Department of Revenue to analyze the possibility of a sales tax exemption on the purchase of processing or manufacturing equipment used to create or use recycled feedstock.

5.1.4 Develop Two Public Databases to Better Connect Industry Stakeholders

As noted in *Chapter Four*, the Exchange model did not ultimately prove to be successful because the low number of trade transactions; the impersonal nature of the internet and quality concerns did not encourage buyers and sellers to purchase materials from the Exchange. Therefore, instead of looking at an online trading model, the Center should provide a place for manufacturers and recycling processors to build relationships and share knowledge, which has the potential for medium market impacts. To start, the Center should build a database for recycling processors and MRFs and a database for manufacturers who use or are interested in using recycled feedstock. The database should include the facilities' materials used, contact information, and any other relevant attributes. The Center should also use this database list to market any advancements that it uncovers through its research. Because of the ability to create this resource with the Center's current allocated staff and resources, the cost would be low and the institutional feasibility would be high, which make it an attractive option. Once the regional partnership becomes more established, the database could expand to include a forum to share information regarding processes and technology, which the Center would moderate.

We recommend that the Recycling Development Center:

1) Build two databases: one for recycling processors and MRFs and one for manufacturers who use or are interested in using recycled feedstock.

2) Make these databases public on the Center's website.

3) Expand the databases to allow members of the database access to an online forum to share information regarding processes and technology.

4) Partner with members of the regional partnership to expand the databases to include facilities in surrounding states.

5.1.5 Research Infrastructure Needs

As stated in *Section 2.5*, the state of Washington currently has 264 MRFs and no PRFs. What's more, our stakeholder interviews determined that processing of mixed paper and plastics #1 and #2 and plastics #3 through #7 are of utmost importance to both municipalities and the industry. According to the 2016 Department of Ecology report, "Optimizing the Commingled Residential Curbside Recycling Systems in Northwest Washington," a workgroup determined that Ecology should "explore the possibility for funding and siting a PRF in the Northwest region." The report suggested that a PRF located in a densely populated area of Washington, such as Seattle, would allow for collection and processing of existing curbside plastics, as well as the ability to collect and process plastics from a greater range of sources.[83]

We recommend that the Recycling Development Center:

1) Research and contact existing PRFs in the U.S. Cities with existing PRFs include: Atlanta, Baltimore, Los Angeles, Newmanstown, PA, New Albany, IN, and St. Louis.

2) Contact British Columbia's PRFs to understand limits on future capacity and analyze the economic and environmental benefits and costs of transporting regional plastic to these locations for processing.

3) Per the "Optimizing the Commingled Residential Curbside Recycling Systems in Northwest Washington" report, review the "Oregon Plastics Recovery Assessment"[84] for a detailed economic assessment of PRFs.

4) Contact Oregon's DEQ to discuss a potential partnership for siting a PRF in the Pacific Northwest.

5) Consider siting a PRF in close proximity to an existing MRF in a densely populated area of the state.

5.1.6 Future Considerations

In the longer term, the Recycling Development Center should consider tackling the additional focus areas identified in *Section 4.3* of education, contractual assistance, and policy assistance, contingent on the Center's resources and objectives at that time. While marked white in *Figure 2: Focus Areas Chart* to denote a lower priority than the ones marked green, these focus areas were still prevalent concerns of a handful of interviewees, and our case studies and literature review highlight the benefits of these additional areas.

The interviewees frequently listed education as a top priority for the Recycling Development Center, expressing the importance of the government's role in communicating to the public on reducing contamination and reducing consumerist behaviors altogether. However, we deemed the outreach efforts from both municipalities and the Recycling Development Center

potentially redundant. This points to an opportunity for the Recycling Development Center to coordinate with the relevant outreach actors within Ecology to create a more effective educational campaign strategy and consistent branding of recycling throughout the state. We highly encourage Ecology to emulate the recycling partnerships and development councils from our case studies to develop newsletters, social media and teaching toolkits, online resources, workshops, conferences, and other communication strategies.

Professional experts that we interviewed expressed mixed feelings about the Recycling Development Center's focus on contractual assistance. The ones that requested contractual assistance claimed they wished to obtain more technical support from the Center, as they were skeptical of the Center's capacity to identity markets and research market trends before the industry experts could. One industry expert mentioned having difficulty with writing contracts, especially with determining the appropriate pricing levels and wording. Therefore, a few requested the Center provide contractual templates and buying guides online for their use.

Policy assistance is aligned with the research focus area. With overlapping activities and objectives, working toward one of these two focus areas (policy assistance or research) would reinforce the other focus area. For instance, as illustrated in our *Focus Areas Chart*, PRFs is an overlapping topic of interest for both focus areas; the research performed on PRFs will naturally assist policy makers in writing or supporting related policies. Therefore, in terms of resources, policy assistance would be the optimal option above education and contractual assistance because it would require the least amount of additional resources.

5.2 Proposed Work Plans for Fiscal Years 2020 and 2021

The work plans developed below are derived from the fiscal note for HB 1543. They prioritize the recommendations made in this report and detail the staff and consultant requirements to accomplish these projects. The main undertakings for Fiscal Years 2020 and 2021 include: the development of a regional partnership, the creation of databases for regional buyers and sellers of recycled feedstock, the introduction of an accelerator program, and the research of recycling markets' infrastructure needs and of Washington State's attractiveness for manufacturing investments. The full work plans for these years can be seen in *Figure 7* and *Figure 8*, and the staffing overview can be found in *Figure 9*. Expanded descriptions of the projects within the work plans and potential future projects are below, as well as suggestions for future projects beyond the first two years of operations. As noted in the fiscal note of House Bill 1543, the work plans assume that hiring the staff for the Center takes until December 2019.

5.2.1 Major Proposed Projects for Fiscal Years 2020 and 2021

- *Regional Partnership Development* – During the first year of the Center, the Environmental Planner 5 should begin building relationships with recycling managers

and industry leaders from the public and private sectors in British Columbia, Oregon, and Washington. The idea for a regional partnership should be introduced to gauge interest in this group. In the second year, a meeting with all interested stakeholders should be coordinated to begin the process of developing a regional partnership for improving secondary markets for recycled materials. At this meeting, attendees should discuss the preferred model for this partnership and decide the basic organizational structure for the members. Moving forward, this group will align their secondary market development efforts and share resources and innovations among members. Depending on the model that the Center and partners ultimately decide upon, a portion of the potential grant dedicated to public institutions working on recycling market development could be used to build this regional partnership organization.

- *Databases Development* – In the Center's first year, the Commerce Specialist 4 and the Environmental Specialist 4 should develop a database to connect the suppliers and purchasers of recycled feedstock to improve the coordination between these two parties. It should be developed in the first year using an easy-to-update, web-based database service. After its initial creation, the Commerce Specialist 4 will maintain a list of manufacturers in the region, which use or could use recycled feedstock, and the Environmental Specialist 4 will maintain a list of MRFs and recycling facilities in the region that could supply these manufacturers with feedstock. This list should be made public on the Center's webpage and should be consistently updated with new information on the entities. The Center can also send news or relevant information to the members of these databases.

- *Accelerator Program* – Overseen by Commerce staff with input from Ecology, the accelerator program should be run by a consultant firm, due to capacity constraints of the Center's staff. The Center should draft and issue a national RFP for this firm in FY 2021. The RFP should include requirements for the firm to have knowledge in material science, the recycling industry, and in manufacturing processes. This RFP process would be led by the Commerce Specialist 4 with assistance from the Environmental Specialist 4. Once the bid has been awarded, the consulting firm will develop the accelerator program, including its program design, work plan, program RFP, and an outreach plan. This work should conclude in June 2021, and the program RFP for participants should be issued in early FY 2022.

- *Research Areas* –

    - *Infrastructure Needs:* Due to the capacity constraints of the Center's staff, the Center should hire a consultant to research the infrastructure needs for mixed paper and plastic end use, using the potential grant funding for research on market developments. The RFP for this consultant should be drafted and issued in FY 2020, and the consultant firm should begin its research in June 2020. The consultant should submit a report to the Center by January 2021. The report should focus on the infrastructure needs for paper and mixed plastic recycling and

the use of these materials as feedstock. It should outline opportunities for paper mills and PRFs in Washington, as well as the barriers facing these facilities. This RFP process would be led by the Environmental Planner 4 with assistance from the Environmental Specialist 4. The findings of the report should be shared with manufacturers, recycling facilities and local governments, and these entities should be surveyed to find any opportunities to implement the findings of the report.

- *Strategies to Attract Manufacturing Facilities Using Recycled Feedstocks:* While the Center has funding for initial grant opportunities, the Center should hire a consultant to study Washington's competitiveness in terms of attracting manufacturing facilities interested in using recycled feedstock to locate within the state. The consultant should make recommendations on how the state could increase its competitiveness in this area. The RFP for this consultant should be drafted and issued in 2020, and the consultant firm should begin its research in June 2020. By January 2021, the consultant should deliver a report to the Center with an analysis of the current market needs and a recommendation for a long-term incentive model that the Center could proposed to the Legislature. This RFP process would be led by the Commerce Specialist 4 with assistance from the Environmental Planner 4 and Environmental Specialist 4. Based on the report by the consultant, the Commerce Specialist 4 will finalize a model to improve Washington State's competitiveness in regards to attracting manufacturing facilities interested in using recycled feedstock by June 2021.

5.2.2 Advisory Board

As required in HB 1543, the Director of the Center will consult with the Department of Commerce to fill the Center's advisory board. The legislation requires that the member positions include:

- One member to represent cities
- One member to represent counties east of the crest of the Cascade mountains
- One member to represent counties west of the crest of the Cascade mountains
- One member to represent public interest groups
- Three members from universities or state and federal research institutions
- Up to seven private sector members to represent all aspects of the recycling materials system

        - Including but not limited to manufacturing and packaging, and solid waste management
        - Initially, members from the private sector serve the following terms:
            - Three members serve three-year terms
            - Four members serve two-year terms
                - After which time, every member in this group serves two-year renewable terms.
- The chair of the utilities and transportation commission or the chair's designee as a nonvoting member
- Nonvoting, temporary appointments to the board may be made by the chair of the advisory board where specific expertise is needed

When selecting for this advisory board, the Director should select members who will help guide the Center to focus on its mission. When selecting members for the advisory group, we recommend that the Center consider a diverse set of stakeholders, reaching out to groups including tribal members, small or local manufacturing companies, and smaller cities or counties. These members should have the ability to focus on the overall secondary market development and not solely on the desires or objectives of their companies or municipalities.

Once the advisory committee is chosen, the Director should task the board with developing a charter for the group. This charter should align with the board's role outlined in HB 1543; the advisory board should provide support and recommendations for the Center's annual work plan, and it should guide the Center's staff, the Director of the Center, and the Department of Commerce regarding any staff policies that could affect the development of secondary markets for recycled materials.

When developing this charter, the advisory board should look at the focus of other relevant advisory boards, such as the SWAC and Recycling Stakeholder Committee, to ensure that their mission and focus does not duplicate the efforts happening elsewhere in Ecology or the state. The advisory board should elect one member to serve as a liaison to other relevant advisory boards, such as the Solid Waste Advisory Committee (SWAC) and the Recycling Stakeholder Committee. This member should regularly attend those meeting and present Center updates to these groups. They should also report any relevant information or news from these meetings back to the Center staff and advisory board. This member should look for opportunities for partnerships or for sharing resources among the groups, such as lessons learned regarding educational campaigns.

5.2.3 Future Proposed Projects

While the proposed work plan only covers the first two years of the Center's operations, a number of other projects, based on the findings in *Chapter Four*, should be pursued in the following years, including:

- *"Design to Recycle" Partnership Program* – This program would connect the manufacturers of goods and packaging with the recycling processing centers to develop products that better flow through MRFs and can be recycled more easily and economically. This could become a part of the regional partnership, depending on the chosen partnership model.

- *Technology Transfers Demonstrations* – This program will build off the work done by the consultant researching infrastructure needs and the accelerator program. If any new research or process has been uncovered and proven successful, the Environmental Planner 4 would coordinate the demonstration of these advancements to other industry members, improving knowledge sharing and the usage rates for recycled feedstocks.

- *"Buy Recycled" Marketing Campaigns* – These educational campaigns should be led by Ecology and can be directed at both the purchasers in governments and residents of Washington State. The Center should partner with the Contracting & Purchasing group within the Department of Enterprise Services to better reach buyers within governments, and should encourage local municipalities to apply for Waste Reduction and Recycling Education grants to educate the public.

- *"Manufacture with Recycled Materials" Marketing Campaigns* – This marketing campaign should be led by Commerce with resources regarding the use of recycled feedstock targeted to relevant manufacturers. Commerce could attend trade shows and business conferences to improve the visibility of the Center within the business community. As a part of this effort, Commerce could pursue voluntary agreements with manufacturers to increase the use of recycled feedstock in their products.

Figure 7: Proposed Work Plan for Fiscal Years 2020

	Resources		Due Date	Timing											
Objective/Task	**Staff**	**Consultant**	Red Indicates a Requirement in HB 1543	**7/19**	**8/19**	**9/19**	**10/19**	**11/19**	**12/19**	**1/20**	**2/20**	**3/20**	**4/20**	**5/20**	**6/20**
Hire Recycling Development Center Staff	ECY HR		Dec 2019												
Outreach to public/private recycling managers and industry leaders in British Columbia, Oregon and Washington to gauge interest in regional partnership for developing secondary markets	EP 5		June 2020												
Research needs of reprocessing and manufacturing firms using recycled materials	CS 4		June 2020												
Develop and maintain database of manufacturers that use or may use recycled mixed paper or plastic as feedstock	CS 4		June 2020												
Develop and maintain database of material recovery facilities (MRFs) and recycling facilities	EP 4		June 2020												
Develop a website for the Recycling Development Center, which houses the databases and resources for manufacturers, recycling facilities and municipalities	EP 5, CS 4, EP 4, ES 4, ECY IT		June 2020												
Reach out to a diverse set of stakeholders to select the advisory board	EP 5, Commerce		May 2020												
Finalize the advisory board membership	EP 5, Commerce		June 2020												
Draft RFP for infrastructure needs research	EP 4, ES 4		March 2020												
Draft RFP for strategies to attract manufacturing facilities using recycled feedstock research	CS 4, EP 4, ES 4		March 2020												
Quarterly advisory board meeting attendance and support	EP 5, EP 4		On Going												
Facilitate key stakeholder planning sessions for mixed paper and plastic to better understand the current environment	EP5, EP 4, CS 4		June 2020												
Issue RFP for infrastructure needs research	EP 4, ES 4		April 2020												
Issue RFP for strategies to attract manufacturing facilities using recycled feedstock research	CS 4, EP 4, ES 4		April 2020												
Develop a grant program for local governments for the development and implementation of contamination reduction and outreach plans	ES 4		May 2020												
Develop a report to the Legislature and the Governor about the Center's progress	EP 5		May 2020												
Choose date and location for an initial meeting to discuss the regional partnership model with interested stakeholders	EP 5		June 2020												
Award and notify bidders of grant selections	EP 5, EP 4, ES 4		June 2020												
Advertise the grant program for local governments for the development and implementation of contamination reduction and outreach plans	ES 4		June 2020												
Submit report to the Legislature and the Governor about the Center's progress	EP 5		June 2020												
Finalize and submit Work Plan for FY 2021	EP 5		June 2020												

Figure 8: Proposed Work Plan for Fiscal Years 2021

	Resources		Due Date	Timing											
Objective/Task	**Staff**	**Consultant**	Red Indicates a Requirement in HB 1543	**7/20**	**8/20**	**9/20**	**10/20**	**11/20**	**12/20**	**1/21**	**2/21**	**3/21**	**4/21**	**5/21**	**6/21**
Evaluate, analyze, and make recommendations on initiatives introduced into the Washington Legislature that involve recycling or materials management	EP 5		On Going												
Maintain and update a database of manufacturers which use or may use recycled mixed paper or plastic as feedstock	CS 4		On Going												
Send information regarding new technologies or opportunities for manufacturers to use recycled materials as feedstock	CS4		On Going												
Maintain and update a database of material recovery facilities (MRFs) and recycling facilities	EP 4		On Going												
Send information regarding market development for recyclable materials to state agencies, counties, and regional partners	EP 4		On Going												
Quarterly advisory board meeting attendance and support	EP 5, EP 4		On Going												
Attend other relevant advisory board meetings, present Center updates to these groups, and report any relevant information or news from these meetings back to the Center staff and advisory board	Elected advisory board member		On Going												
Develop statewide Contamination Reduction and Outreach Plan	ES4		June 2021												
Oversee infrastructure needs research	EP 4, ES 4	Yes	December 2020												
Oversee strategies to attract manufacturing facilities using recycled feedstock research	CS 4, EP 4, ES 4	Yes	December 2020												
Develop the charter for the advisory board	Advisory Board		September 2020												
Draft RFP for consultant to oversee the accelerator program	CS 5, ES4		August 2020												
Award the grants for local governments for the development and implementation of contamination reduction and outreach plans	ES 4		August 2020												
Oversee the grant program for local governments for the development and implementation of contamination reduction and outreach plans	ES 4		February 2021												
Issue RFP for consultant to oversee the accelerator program	CS 5, ES4		September 2020												
Meet with interested stakeholders and partners regarding the regional partnership	EP 5		October 2020												
Finalize the charter for the advisory board	Advisory Board		October 2020												
Award and notify bidders of RPF selection	EP 5, ES4		November 2020												
Develop membership model and organization structure for the regional partnership	EP 5		December 2020												
Develop accelerator program, including program design and work plan, program RFP, and an outreach plan	CS 4, ES 4	Yes	June 2021												
Finalize and submit statewide Contamination Reduction and Outreach Plan	EP 5, ES4		January 2021												
Consultant report on infrastructure needs research	EP 4, ES 4	Yes	January 2021												
Consultant report on strategies to attract manufacturing facilities using recycled feedstock research	CS 4, EP 4, ES 4	Yes	January 2021												
Finalize membership model and organization structure for the regional partnership	EP 5		January 2021												
Develop FY 2022 Work Plan	EP 5		March 2021												
Hold first meeting with regional partnership members to develop mission, vision, and objectives	EP 5, CS 4, EP 4, ES 4		April 2021												
Send infrastructure needs research to manufacturers, recycling facilities, and local municipalities	EP 4, CS 4		April 2021												
Survey manufacturers, recycling facilities, and local municipalities regarding infrastructure needs to uncover any opportunities to implement the findings from this report	EP 4, CS 4		May 2021												
Finalize any strategies to attract manufacturing facilities using recycled feedstock to recommend to the Legislature	CS 4		June 2021												
Launch and run business accelerator program for manufacturers looking to use recycled feedstock in Washington State	CS 4, EP 4	Yes	June 2021												
Submit FY 2022 Work Plan	EP 5		June 2021												

Figure 9: Staffing Overview

Department	Staff	Defined Duties
Ecology	Environmental Planner 5 (EP5)	Directs the operations and activities of the Center, collaborates with key stakeholders, engages in regional and national efforts, and represents the Center on the advisory board as a designee from Ecology.
Ecology	Environmental Planner 4 (EP4)	Serves as the lead for grants and contracts management, obtains and disseminates market development information, provides business and marketing assistance to public and private entities, and writes the legislative report to the Legislature and the Governor in even numbered years.
Ecology	Environmental Specialist 4 (ES4)	Serves as the financial manager for all agreements, in addition to managing less complex grants and contracts, and works on the statewide Contamination Reduction and Outreach Plan (CROP).
Ecology	Administrative Assistant 2	Provides administrative support for the Center, including coordinating meetings, meeting preparations and notes taking, travel arrangements, and distributing guidance from the board to the Center.
Commerce	Commerce Specialist 4 (CS4)	FY 20: Researches the unmet needs of reprocessing and manufacturing firms using recycled materials and researches the waste stream supply chain and incentive strategies. FY 21–25: Provides targeted assistance to recycling businesses, including the development of business plans, and supports, promotes, and defines research and development to stimulate new technologies and products using recycled materials.
UTC	Regulatory Analyst 3	Member of Advisory Board.

Chapter Six: Conclusion

As we conclude writing this report, HB 1543 has only just recently been signed into law by Washington State Governor Jay Inslee. This report is intended to inform the development of the Recycling Development Center in the face of a rapidly changing recycling industry and the need to improve secondary markets in Washington State for recycled materials. In our research, which included interviews with 31 industry leaders and technical experts and the analysis of 11 case studies from around the country, we found that there are a plethora of options and strategies to respond to changing markets and China's National Sword policy. Based on the most effective approaches that the Center can take to reduce overall waste and increase recycling rates, we recommend that Ecology employ an integrated approach and prioritize the development of a regional partnership, create an accelerator program, research strategies to attract manufacturing facilities using recycled feedstocks, develop two public databases to better connect industry stakeholders, and research infrastructure needs.

Recycling markets are a rapidly changing and significant issue. Washington State has a unique opportunity to rise to the challenge, become a regional leader, and develop essential secondary markets.

Appendices

Appendix 1. Interview List

Name of Interviewee	Organization	Sector
Alicia Marseille	ASU	University
Ashlee Yee	CalRecycle	Government
Brenda Blanchfield	Chelan County	Government
Ron Jones	City of Olympia	Government
John Yeasting	CWC	Government
Julie Burman	CWC	Government
Preston Horne-Brine	CWC	Government
Gene Clark	Island County	Government
Andy Smith	King County	Government
Chris Piercy	Kitsap County Public Works	Government
Troy Lautenbach	Lautenbach Recycling	Private
Justin Gash	Oregon DEQ	Government
Peter Spendelow	Oregon DEQ	Government
Dave Claugus	Pioneer Recycling	Private
Matt Morrison	PNWER	Non-Profit
Derek Ruckman	Recology	Private
Kevin Kelly	Recology	Private
Dylan DeThomas	Recycling Partnership	Non-profit/Association
Erik Makinson	Resource Synergy	Private
Beth Coddington	RRS - Consultant for Colorado's NextCycle	Private
Sego Jackson	Seattle Public Utilities	Government
Will Sagar	SERDC	Non-profit/Association
Lance Newkirk	Shoreline Public Works	Government
Margo Gillaspy	Skagit County Public Works	Government
Kevin Ruuhela	Snohomish County	Government
Steve Wulf	Sunshine Disposal & Recycling	Private
Nina Goodrich	Sustainable Packaging Coalition	Non-profit/Association
Mike Young & Co.	Utilities and Transportation Commission (UTC)	Government
Chris Green	Washington Department of Commerce	Government
Susan Robinson	Waste Management	Private
Heather Trim	Zero Waste Washington	Non-profit/Association

Appendix 2. Case Study Overview

	Program or Organization's Name	Location	Type of Program or Organization	Focus and/or Objectives	Organizational Structure	Key Takeaways or Resources
Government Programs	Clean Washington Center (Defunct)	Washington State	Department of Trade and Economic Development Program; transitioned to a non-profit	Material research: old newspapers, glass containers, high density polyethylene (HDPE) milk jugs, polyethylene terephthalate (PET), and yard waste. Technical assistance for businesses. Sought to make the use of recycled feedstock cost competitive.	24 staff members, working in five functional areas.	Grants funded materials and recycling infrastructure research. Keep the mission targeted. Develop strong relationships with industry.
	Local Assistance and Market Development (See Chapter 4 of report for more information)	California	CalRecycle Program	Provides local grants, financing opportunities, facility siting and permitting assistance, and technical support.	Administered by staff with CalRecycle, which partners with the Governor's Office of Business and Economic Development.	Offers targeted grants for recycling of specific products, and low-interest loans to companies that are in designated recycling zones or that reduce greenhouse gas emissions.
	NextCycle (See page Chapter 4 of report for more information)	Colorado	Department of Public Health & Environment Program	A business incubator that started in 2019, offers technical assistance, data sharing and a platform to pitch their ideas to companies with plans to use recycled materials in a manufacturing process.	A consultant company administers the program and works with one liaison from the Department of Public Health & Environment.	Offers $5,000 grants as seed money. Allows participants to learn lessons from and offer advice to each other.
	Recycling Business Assistance Program[1]	North Carolina	Department of Environmental Quality Program	Provides information on recycling markets, external financing options, assistance with permitting or facility siting. Offers grants to businesses using recycled materials.	Administered by a staff of six within the Department of Environmental Quality.	Grants up to $40,000 for increasing capacity to use recycled materials, not to general operational costs.
	Recycling Business Development Grant[2]	Massachusetts	Department of Environmental Protection Program	Provides manufacturers and recycling processors with grants.	Administered by staff within the Department of Environmental Protection.	Grants range from $50,000 to $400,000. Apply to certain eligible materials, such as container glass and mattresses. Businesses must provide a minimum match of 25 percent.

[1]"North Carolina Department of Environmental Quality." NC DEQ, deq.nc.gov/conservation/recycling-business-assistance/recycling-business-assistance.
[2]"Apply for a Recycling Business Development Grant." Mass.gov, www.mass.gov/how-to/apply-for-a-recycling-business-development-grant.

Government Programs	Recycling Markets Center[3]	Pennsylvania	Non-profit developed by Department of Environmental Protection	Gives technical business assistance, connects businesses with research bodies to accelerate a product's time-to-market, and supports the business when it is navigating start up regulations.	Five staff members, overseen by a 16-person Board of Directors.	Holds regular summits, webinars, and forums on key material categories.
	Recycling Market Development Program [4]	Indiana	Department of Environmental Management Program	Provides funding for projects looking to reduce the amount of landfilled MSW, to increase recyclable material collection or consumption, or improve community relations regarding recycling.	Operates under a Board, consisting of nine voting members, appointed by the governor's office, as well as seven non-voting ex officio members.	Provides grants of $1,000 to $500,000 from Recycling Promotion and Assistance Fund. Requires businesses to match funding. In 2017, it issued a total of $1 million in grants.
	Recycling Market Development Program[5]	Minnesota	Pollution Control Agency Program	Connects business with a number of resources for recycled materials: technical information, recycler and material processor lists, material data, and state-specific legislation on recycling.	Administered by staff within the Pollution Control Agency.	Will refer business for financing, permitting, and business plan support.
	Re:Source Program[6]	Michigan	Economic Development Corporation/ Department of Environmental Quality Program	Offers private activity bond financing to manufacturers, not-for-profit corporation projects, and solid or hazardous waste disposal facilities. Maintains the Recycled Materials Market Directory for businesses to locate recyclers.	Administered as a joint effort between the two state agencies.	Private activity bond financing of up to $10 million from its Michigan Strategic Fund. $1 million free of any restrictions on capital expenditures.
Recycling Development Councils	Southeast Recycling Development Council	Southeast U.S.	Development Council; Nonprofit	Fosters partnerships through direct participation, events, and grants. Conducts outreach and public education and recommends best practices.	Two staff members, overseen by an executive committee, a 12-member general board, and an ex-officio committee	Provides financial assistance through grant programs, sponsored by partnerships between different sectors.
	Northeast Recycling Council	Northeast U.S.	Development Council; Nonprofit	Assists in research, technical assistance, demonstration projects, and education.	Five current staff members, overseen by 11 board members—one from each of the 11 member states	Provide consultative services, meaning that the work of the council will be

[3]"RMC Progress Summary." Pennsylvania Recycling Markets Center. https://pennrmc.org/summary/
[4]"Indiana Recycling Market Development Program." IN.gov. https://www.in.gov/idem/recycle/2358.htm
[5]"Recycling Market Development." Minnesota Pollution Control Agency, 6 July 2018, www.pca.state.mn.us/waste/recycling-market-development.
[6]"Private Activity Bond Program." Michigan Economic Development Corporation.
https://www.michiganbusiness.org/4911c8/globalassets/documents/reports/fact-sheets/privateactivitybondprogramformeridrb.pdf

						determined by the given projects. Form committees within the council focusing on a priority material or subject identified by the board.
	Recycling Council of British Columbia	British Columbia, Canada	Development Council; Nonprofit	Serves mainly as an information center regarding the province's extended producer responsibility programs, curbside recycling programs, and other waste reduction and reuse options.	Nine personnel members, overseen by a 12-member board.	Develop strong educational services, such as mobile recycle encyclopedia and hotline services, to readily answer the community's questions.
Recycling Partnerships	Alabama Recycling Partnership	Alabama	Partnership	Analyzes best recycling management practices, the economic impact of the state's recycling industry, the impact of ADEM's grant program on material recovery, and a hub-and-spoke model design for the processing of materials.	10+ members, including SERDC, local governments, and private businesses.	Introduce a common, consistent suite of materials, recycling branding, data reporting system, and a grant program to be used throughout the state.
	Arizona State University RISN Incubator	Arizona	Partnership	Promote a circular economy in the Phoenix area by operating an accelerator for small waste-to-product businesses.	Managed and operated by the Sustainability Solutions Services, a program within the Walton Sustainability Initiatives at ASU. The City of Phoenix provides funding and infrastructure for the program. It owns the RIC land and manages the leases to cohort members.	Utilizes the resources and knowledge of higher education institutions. Offers land leases to businesses and connects businesses to recycled materials.
	Beyond 34 Pilot Project	Florida	Partnership	Studies best practices for a public-private partnership to increase the 2014 national recycling rate of 34 percent and to promote a circular economy.	Partnership included the Project Founders (including UCCF) , the City of Orlando, Orange County, Orlando Regional Chamber of Commerce, as well as leading brands, manufacturers, retailers, industrial service providers, and more unique partners, including school districts and theme parks.	Organize a recycling champions' network by engaging public and private stakeholders through a collaborative communications campaign.

	Chicago Board of Trade Recyclables Exchange (Defunct)	Located in Chicago, but trading occured online	For profit, developed in partnership with government entities	Offered an online forum to buy and sell recovered materials. Improved consistency for material specifications.	Developed in collaboration with the National Recycling Coalition's Recycling Advisory Council, the CWC, the New York State Office of Recycling Market Development , and the U.S. EPA's Office of Solid Waste.	Lacked enough trade transactions and lacked a commitment from larger buyers and sellers.
	Recycling Partnership	Nationwide	Partnership	Supports the recycling industry through 1) grants, technical assistance and tools; 2) research, measurement, and best practices; 3) partnerships; and 4) scale (coverage).	33 staff members, supported by 40+ funding partners.	Include scale as a criterion for decisions. Define measures for scale and success.

Appendix 3. List of Relevant Legislative Bills and State Codes

- *1969 – Engrossed House Bill No. 596 – Established an act relating to environmental quality; providing procedures for solid waste management; providing penalties; and declaring effective dates. This bill establishes the majority of RCW 70.95.010.*
- *1984 – Substitute House Bill No. 1164 – Established priorities in the following order: (a) Waste reduction; (b) Waste recycling; (c) Energy recovery or incineration; and (d) Landfill. The bill defined waste reduction and waste recycling. It defined the Department of Ecology's role in the review of waste management plans, as well as required it to provide technical assistance in the creation of plans, and gave it discretionary power to disburse funds for solid waste recovery and recycling programs.*
- *1989 – Substitute House Bill No. 1671 – Made a significant number of amendments to RCW 70.95, especially around waste reduction and recycling. Among the many changes, the bill eliminated waste management priorities established in 1984. It also made waste reduction and source separation mandated strategies in state waste management practices and provided a significant amount of guidance on incorporation of recycling and waste reduction in comprehensive waste management plans. It further defined recyclable materials and defined recycling and source separation. It further defined the Department of Ecology's role in management and implementation of waste reduction and recycling plans.*
- *1991 – Substitute Senate Bill No. 5478 – Expanded curbside recycling to multi-family residences, stating that "the legislature finds that curbside recycling services should be provided in multiple-family residences. The county and city comprehensive solid waste management plans should include provisions for such service" (1991 c 298 § 1).*
- *2002 – Substitute House Bill 2308 – Established requirements around construction waste and yard debris. It also established goals for state use of recycled or environmentally preferable products.*
- *2010 – Second Substitute House Bill No. 2539 – Further defined the state's recycling policy, stating "Increasing available residential curbside service for solid waste, recyclable, and compostable materials provides enumerable public benefits for all of Washington. Not only will increased service provide better system-wide efficiency, but it will also result in job creation, pollution reduction, and energy conservation, all of which serve to improve the quality of life in Washington communities. It is therefore the intent of the legislature that Washington strive[s] to significantly increase current residential recycling rates by 2020" (2010 c 154 § 1)*

The most pertinent sections of RCW 70.95 for the purposes of this report include the following:

- *RCW 70.95.010 – Legislative finding—Priorities—Goals.*
- *RCW 70.95.030 – Definitions.*
- *RCW 70.95.080 – County comprehensive solid waste management plan—Joint plans—Requirements when updating—Duties of cities.*
- *RCW 70.95.090 – County and city comprehensive solid waste management plans—Contents.*
- *RCW 70.95.096 – Utilities and transportation commission to review local plan's assessment of cost impacts on rates.*
- *RCW 70.95.100 – Technical assistance for plan preparation—Guidelines—Informational materials and programs.*
- *RCW 70.95.260 – Duties of department—State solid waste management plan—Assistance—Coordination—Tire recycling.*
- *RCW 70.95.263 – Additional powers and duties of department.*
- *RCW 70.95.265 – Department to cooperate with public and private departments, agencies, and associations.*
- *RCW 70.95.267 – Department authorized to disburse referendum 26 (RCW 43.83.330) fund for local government solid waste projects.*
- *RCW 70.95.268 – Department authorized to disburse funds under RCW 43.83.350 for local government solid waste projects.*
- *RCW 70.95.280 – Determination of best solid waste management practices—Department to develop method to monitor waste stream—Collectors to report quantity and quality of waste—Confidentiality of proprietary information.*
- *RCW 70.95.285 – Solid waste stream analysis.*
- *RCW 70.95.290 – Solid waste stream evaluation.*
- *RCW 70.95.295 – Analysis and evaluation to be incorporated in state solid waste management plan.*
- *RCW 70.95.410 – Transporters—Delivery of recyclable materials to transfer station or landfill prohibited—Records—Penalty.*
- *RCW 70.95.430 – Solid waste recyclers—Notice—Report—Penalty.*

- *RCW 70.95.440 – Financial assurance requirements.*
- *RCW 70.95.600 – Educational material promoting household waste reduction and recycling.*
- *RCW 70.95.903 – Application of chapter—Collection and transportation of recyclable materials by recycling companies or nonprofit entities—Reuse or reclamation.*

Appendix 4. Life-cycle (Process and Transportation) Energy, Using Virgin Versus Recycled Inputs[85]

Material	Virgin Inputs (100%)			Recycled Inputs (100%)			Percent Reduction in Total Energy[86]
	Process Energy per Short Ton (Million Btu)	Transportation Energy per Short Ton (Million Btu)	Total	Process Energy per Short Ton (Million Btu)	Transportation Energy per Short Ton (Million Btu)	Total	
Corrugated Cardboard	25.13	1.31	26.44	11.73	0.80	12.53	53%
Office Paper	37.01	n/a	n/a	20.12	n/a	n/a	n/a
Mixed Paper	n/a	n/a	n/a	11.95	0.23	12.18	n/a
Newspaper	39.92	0.50	40.42	21.98	0.03	22.01	46%
Glass	6.49	0.58	7.08	4.34	0.34	4.66	34%
Metal - Aluminum	115.16	0.56	115.72	4.50	0.22	4.72	96%
Metal - Steel	31.58	4.60	36.18	11.78	4.03	15.81	56%
Plastics #1 PET/PETE	28.25	1.00	29.25	12.02	2.60	14.62	50%
Plastics #2 HDPE	23.68	2.74	26.42	5.33	2.31	7.64	71%
Plastics #3 PVC	30.25	1.46	31.71	n/a	n/a	n/a	n/a
Plastics #4 LDPE	27.77	2.79	30.56	n/a	n/a	n/a	n/a
Plastics #5 PP	23.62	2.36	25.98	n/a	n/a	n/a	n/a
Plastics #6 PS	35.86	2.36	38.22	n/a	n/a	n/a	n/a

Appendix 5. Interview Findings Matrix

Finding / Recommendation	Action	Times Mentioned	Linked Recommendation
The Center can develop a mandatory recycling content law, particularly for post-consumer recycled content.	Policy Development	1	
The Center can create more robust buying guides for government. The Center should provide contractual templates (prices, wording), short monthly/weekly online newsletters, yellow sheets, and seed money.	Contractual Assistance	2	
The Center needs to change the messaging, so that residents don't expect that recycling is free. Residents need to think of it as more that it's a manufacturing good. The Center needs to steer the public to focus more on reducing.	Communication	2	
Oregon and Washington should partner.	Partnerships	1	
The Center should hold workshops with messaging on contamination reduction.	Communication	2	
Mixed paper is a big issue. Resorting costs way more than the material is worth. The biggest challenge is cost. Processing costs are rising because the most significant portion of the mix (mixed paper) is lacking a market. Only China could really handle these mixed papers. Washington needs paper mills that can handle commingled paper and needs to update their paper mills. The Center can facilitate the siting of a mixed paper resorting operation and mixed plastic recycling processor in the Northwest.	N/A	6	Reduce the number of MRFs through regulation or secondary MRFs to process residue.
The Center should divert funds through grants. Ecology only grants money to nonprofits and municipalities, and not to for-profit.	Financial Assistance	2	E.g. Grant for optical sorter or an anti-contamination campaign, grants for secondary processors, short-term grants to keep someone in town, or to keep a mill open.
Plastics #3-#7 should be recycled. EFS (east coast) focuses on these plastics and want to open a West Coast facility. Need MRF to process and clean contaminated materials. They could be turned into fuel, pellets, and flakes.	N/A	2	Research opportunity and benefit/cost for a potential MRF facility for recycling Plastics #3-7.
Glass is expensive and should be put into separate bins.	N/A	1	
Aluminum is currently sent out, but should be processed within the state.	N/A	1	

The first priority of the Center should be to look at barriers to market development. Employees within Commerce should be doing research for the first year.	Research	1	
The Center needs to know what kind of money is needed to incentivize people to do work in Washington and what kind of money is needed (match, small grants, etc.).	Research/ Financial Assistance	1	
Green building products can displace a lot of virgin materials in high volume and high performance. Feedstock can be from recycled materials, such as paper and plastics in drywall or flexible packaging inputs as fibers. Currently, virgin paper stock is very cheap, which makes it hard.	N/A	3	
There have been talks of PRFs, a second facility that receives just the paper or just the plastic from the MRFs ad sorts it down further into those individual grades. In doing so, they bump the value of the commodity from $5 to $180.	Research/ Policy Development	2	
Grants were able to identify facilities that demanded recoverable materials.	Financial Assistance	1	
If money is part of the equation, it needs to go to the end-use markets.	Financial Assistance	1	
ASU has a physical space where companies, funded through the accelerator, can set up and pilot programs. How could the regions where the MRFs are located utilize some of this space to allow companies, through an RFP process, set up and process some of the materials there? This could allow for market-based innovations.	N/A	1	Develop and put out an RFP for innovators to solve market issues, using Phoenix as an example.
Some examples of loans and grants that Washington could model after are: greenhouse gas reduction loan, recycling market development revolving loan program, and grants from CalRecycle. Colorado can also be a good example, as they ran grant programs for a decade for RREO programs. They receive revenue from tip fee services from landfill and use it for grants.	Financial Assistance	1	
Grants should not be a fund for a single application, but teams should go into a virtual incubator with small seed business and develop what they are doing (e.g. Colorado).	Financial Assistance	1	
CWC turned into a nonprofit (PNWER) after the legislature did not reup the funding.	N/A	1	
Focus on compost, fiber, and packaging materials.	Material Development	1	
Balance the markets to the East (Washington). Don't rush technology to the smaller markets.	Market Development	1	

Recycling is very regional because transportation has a big effect on prices.	N/A	1	
Ecology should focus on end use and should prioritize current markets first. Fiber markets and metal market remain relatively strong. Research shifting markets not only locally, but also nationally and internationally.	Market Development	1	
Explore product stewardship approach. Require a certain percentage of material content to be recycled, especially in regards to plastic packaging and cardboard.	Policy Development	2	
Focus on mixed plastic and paper. Need a robust collection system for plastic.	Material Development	1	
Ban on things going to the landfill, and do not approve landfill expansion. Need government intervention to regulate landfills to encourage recycling.	Policy Development	1	
Plan bi-monthly meetings (like advisory committees).	Partnership/ Communication	1	
Support an innovation lab, which could evaluate programs, policies, and technologies from around the world, and see what would be best for Washington.	Research	1	
Glass is crucial, but is not a great recyclable material because it is heavy and does not travel well. Glass also comes in three colors and never ends up in the right place because of that.	Material Development	1	
SERDC's main roles were to foster partnerships through direct participation, events, and grants; to conduct outreach and public education; and to recommend best practices by offering frameworks, such as the "pay as you throw" strategy.	N/A	1	
NERC's main services are research, technological assistance, demonstration projects, and education. NERC implemented a joint strategic action plan with the Northeast Waste Management Officials Association.	N/A	1	
Staffing needs for recycling councils are minimal. Most of the Recycling councils only had five current staff members, with positions including executive director, assistant director, special projects manager, office manager, and program manager.	N/A	1	

The recycling councils of BC, Ontario, and Alberta are structured similarly because the latter modeled theirs according to the BC council, which is the oldest one in Canada. They all take a consultative approach and create short-term projects that are sometimes made into regular, long-term programs. Examples of their work include a hotline and encyclopedia that answers residents' questions on which products are recyclable in their area. They also have a materials exchange promoting system. Their goals focus on policy intervention, initiatives, assistance to private sector to responsibly manage their waste stream (including product stewardship), and education.	N/A	1	
The Alabama Recycling Partnership recommended to the state to develop branding for state recycling, improve statewide data reporting systems, and encourage local governments to adopt a common suite of materials in their recycling programs.	N/A	1	
The Beyond34 Case Study recommends to: organize a recycling champion's network, develop a regional plan for recycling, leverage technology to recover more commodity recyclables, develop supportive waste policies and incentives, and engage public and private stakeholders through a collaborative communications campaign.	N/A	1	
One of the challenges CWC faced was that industry needs are not homogenous. The garbage and recycling companies thought the role of the center would be to benefit them, but the CWC focused their attention to compost, wood, and construction.	N/A	1	Form a communication strategy to provide clarity on CWC's target audience and mission.

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Figures 1-3

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