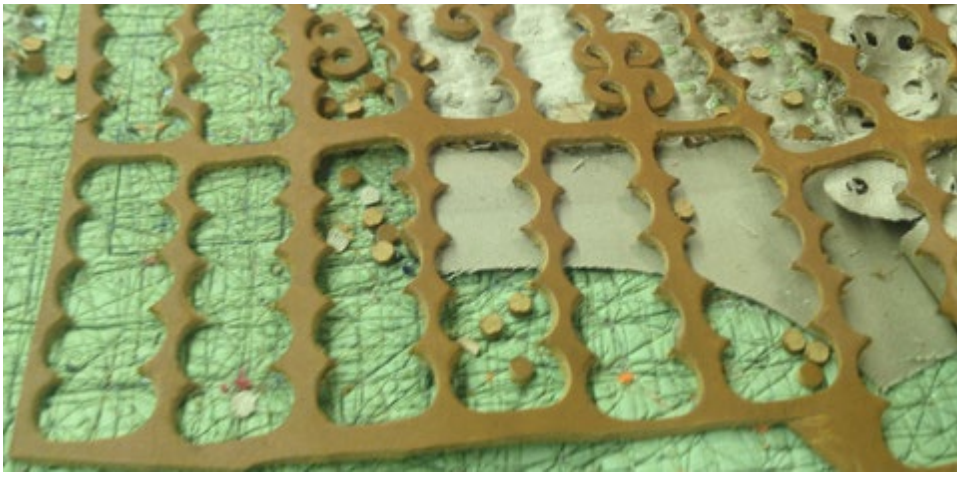
MANUFACTURING BYPRODUCT REUSE NEWARK, NEW JERSEY



FALL 2013 COMMUNITY DEVELOPMENT STUDIO

In partnership with the **City of Newark – Office of Sustainability**

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INTRODUCTION

In partnership with the City of Newark's Office of Sustainability, the Fall 2013 Community Development Studio began a yearlong exploration of Newark's industrial waste stream. The studio's research will support the City's development of a strategy for the productive reuse of manufacturing discards, including durable byproducts and shipping materials. Such a strategy will allow the City to address three primary goals:

1. **Creating new businesses and jobs for Newark residents**
2. **Diverting waste from landfills and incineration**
3. **Supporting Newark's existing manufacturing sector**

A materials reuse program might entail a variety of City-led activities, including incubating new businesses, creating an online platform for materials exchange between firms, operating a retail facility for industrial byproducts, or some combination of these activities. This vision of job creation, waste diversion, and support to manufacturing through materials reuse reflects Newark's mission to equitably advance social, economic, and environmental health, as prioritized in the City's recently updated Sustainability Action Plan (City of Newark, 2013).

Newark boasts a rich history as an American manufacturing hub but its manufacturing sector has shrunk significantly since the mid-twentieth century. However, more than 400 manufacturers are currently active in Newark. These businesses include non-durable manufacturers, such as bakeries, and durable manufacturers, such as screw makers and textile producers. The majority of manufacturers are small-scale establishments that produce pieces within larger supply chains (Mistry, 2013).

To develop a strategy for creating jobs through industrial waste diversion, the Office of Sustainability needs more information about the type, volume, and frequency of materials that manufacturers currently discard, as well as their potential for reuse. To inform the City's strategic planning efforts, the studio 1) conducted a literature review and online research to understand how these issues are handled in other places, 2) met with manufacturers and other experts to develop a site-based research methodology that will be implemented in Spring 2014, and 3) identified additional areas of ongoing investigation that might inform the City's design of a reuse program.

This report begins with an overview of relevant research. Together, a literature review and case study investigations informed our understanding of the different ways materials reuse can be done in a city, the roles that various actors can play in a reuse initiative, and the range of factors that determine whether a certain model is well-suited to a certain location or set of priorities. After summarizing these findings and offering a preliminary discussion of their application in Newark, we move to a discussion of our proposed plan for the Spring 2014 studio. To inform the development of a reuse program for Newark, we outline a methodology for conducting manufacturer site visits to gather information about firms' discarded byproducts, current waste removal processes, and potential interest in such a program. We also indicate directions for simultaneous research that the studio team might conduct, including more in-depth investigation into case study examples, opportunities for expanding the project scope to include additional waste streams, and further consultation with relevant experts as the City's plans progress.

PART I

PRELIMINARY RESEARCH & TAKEAWAYS

GOALS & BENEFITS OF MATERIALS REUSE

A wide range of existing materials reuse initiatives achieve one or more of the City of Newark's three goals of job creation, waste diversion, or support for manufacturing. Although our project scope was initially defined as a City-led program using Newark's industrial discards as inputs, we expanded the scope of our background research to draw relevant lessons from the full range of successful program designs. In the discussion that follows, we discuss relevant themes from (1) initiatives that incorporate residential, commercial, and other waste streams, in addition to industrial byproducts and shipping materials, (2) initiatives implemented at city and regional scales, and (3) initiatives led by private for-profit and non-profit actors in addition to municipalities. While these initiatives differ in scale and inputs from the Office of Sustainability's contemplated approach, they nonetheless provide useful insights into how a reuse strategy might further the City's goals.

Job Creation

Industry experts and researchers have heralded recycling, reuse, and remanufacturing activities as potential drivers of economic development. "Waste-to-Profit" advocates seek to create local jobs through alternatives to waste disposal, pointing to the recycling sector's sustained job growth, from 8.3% to 12.7% annually since 1967 (Institute for Local Self-Reliance, 2002). A recent report by the Tellus Institute projected that diverting 75% of municipal waste from landfill and incineration by 2030 would create 2.3 million jobs. These would include jobs in conventional recycling industries, recycling reliant industries (such as manufacturers using recycled inputs), and reuse and remanufacturing industries (which aim to repurpose discarded products for their original use) (Tellus Institute, 2011).

The US is home to a growing number of reuse, recycling, and remanufacturing businesses. These businesses may draw on commercial or residential waste, or they may locate near existing manufacturers so that they can easily source byproducts for their input streams, including recycled asphalt, glass, metal, paper, plastic, rubber, or wood (Leigh, 2011a). Although they compete with huge firms that mass-produce commercial goods overseas, they tend to be small and locally owned, such that the jobs they create most often stay in the surrounding community (Institute for Local Self-Reliance, 2000). These jobs come from such varied activities as material cleaning, sorting, processing, manufacture, distribution, research and development, marketing, sales, administration, disassembly, inspection, repair/refurbishment, reassembly, and product testing (Leigh, 2011a; Tellus Institute, 2011). Not surprisingly, the quality of these jobs is varied. While traditional non-unionized recycling sorting jobs are low-paid and sometimes dangerous (Riordan & Christman, 2012), remanufacturing jobs are usually associated with relatively high wages (Leigh, 2011a).

For many reuse and recycling activities, business models may be most viable when the market demand and pricing for raw commodities is high. For instance, in cases when it is cheaper to recycle metals, chemicals, or other byproducts than to mine or produce the virgin materials, manufacturers may achieve cost savings by buying recycled inputs at a discount (Leigh, 2011b). Unlike conventional recyclers, remanufacturing businesses that turn reused or recycled materials into finished products may be less vulnerable to the fluctuating market pricing for raw commodities. These business models may potentially garner a steadier revenue stream (Lewis et.al., 1995). One such company, the Trenton, NJ-based TerraCycle, is profiled in the Case Studies section.

Researchers have also investigated how job generation potential and economic development benefits may vary according to the industry and type of reuse activity. While conventional recycling yields more jobs than landfill and incineration, it is less labor-intensive than most reuse and remanufacturing activities, and does not require as many employees. Recycling with a disassembly component produces more jobs because it has less potential for automation and more potential end users, including buyers for raw materials or components (Leigh, 2011a). Berkeley, CA's Urban Ore, discussed in a subsequent case study, exemplifies this concept of "recycling with disassembly." The Institute for Local Self-Reliance (2002) found that making new finished products from discarded materials offered "the largest economic pay-off in the recycling loop." Remanufacturing discards into finished products adds market value to the materials. For instance, old newspapers sell for $30 per ton, while new newsprint sells for $600 per ton (Institute for Local Self-Reliance, 2002).

Waste Diversion

Because reuse businesses flourish in regulatory environments that prioritize waste diversion, city policies may play an important role in incentivizing their development (Leigh, 2011a). In particular, a growing number of cities have adopted aggressive "Zero Waste" targets, along with complementary policies that mandate waste diversion (Ferry, 2011). While such policies are typically focused on diversion of residential and commercial waste, they have important implications for manufacturing sectors, as they encourage resource efficiency among existing firms and create opportunities for new businesses to source discarded materials as inputs.

Zero Waste ordinances can be very successful in reducing the waste a city sends to landfill and incineration. For instance, San Francisco, a leader in the Zero Waste movement, currently diverts more than 80% of its waste from landfills (SF Department of Environment, 2012) as compared with just 26% in New York City (Ferry, 2011). San Francisco's recycling and reuse programs are profiled in the following Case Studies section. Ordinances that require recycling and composting of residential and commercial waste maximize the environmental benefits of diversion by capturing these relatively large waste streams. In many cases, cities with Zero Waste goals also implement pay-as-you-throw (PAYT) policies that penalize individuals and businesses for large volumes of discards. In Brewer, Maine, a policy for residential trash combined with a mandatory recycling policy reduced household trash by half and quadrupled the amount of recyclables collected (Riordan & Christman, 2012). Landfill bans on particular types of discards can also be effective. Most states have landfill bans on electronics, while many localities have passed ordinances mandating the recycling of construction and demolition waste (Leigh, 2011b).

The environmental benefits of waste diversion activities are well documented. The Tellus Institute found that achieving a 75% diversion rate for municipal waste would reduce carbon dioxide emissions by 515 metric tons, equivalent to shutting 72 coal power plants or taking 50 million cars off the road (Tellus Institute, 2011). Not only does waste diversion prevent the release of greenhouse gases and toxic pollutants through incineration, but recycling can also reduce the need for mining and other extraction processes that are themselves environmentally costly. However, the environmental benefits associated with particular materials reuse programs vary depending on the approach. A reuse initiative targeting only a few industrial byproducts might result in limited waste diversion, while other

initiatives might achieve higher waste diversion rates by impacting larger discard streams. In some cases, the environmental benefits from waste diversion could also be offset by detrimental environmental impacts associated with a particular reuse program. For instance, substantially increased trucking to transport materials between manufacturers and end users might release a higher volume of greenhouse gases, while remanufacturing processes might themselves produce harmful emissions or chemicals.

Support for Manufacturing

In addition to furthering job creation and waste diversion goals, materials reuse programs might also be targeted to strengthen an existing manufacturing sector. This has primarily been accomplished through industrial symbiosis projects, defined as practices through which manufacturers may exchange byproducts to their collective competitive advantage (Kincaid & Overcash, 2001; Chertow, 2000). The materials exchanges formed in North Carolina's Research Triangle provide an example of this concept, and are discussed in more detail in the following section. Cost savings from industrial symbiosis result when manufacturers substitute their neighbors' discarded byproducts for more expensive virgin materials (Kincaid & Overcash, 2001). For instance, the Greater Chicago Waste to Profit Network, which facilitates such byproduct synergies between its member corporations, estimates that its activities have generated an aggregate of $17 million in economic impact to these businesses' bottom lines since the network was formed in 2006 (Greater Chicago Waste to Profit Network, 2012). Industrial symbiosis may also generate ancillary benefits in the form of partnership development, equipment sharing, or more efficient information transmission across manufacturing firms.

REUSE IN PRACTICE – CASE STUDIES

The following case studies exemplify existing materials reuse programs and businesses throughout the US. We profile a city-led policy approach to waste diversion, a regional industrial symbiosis project, and two profitable reuse businesses: a salvage and retail operation and a recycling-focused manufacturing firm. Each of these initiatives accomplishes one or more of the City of Newark's goals of job creation, waste diversion, and support for manufacturing. Taken together, they indicate the breadth of materials reuse activities in practice, but are by no means intended to represent the full spectrum of successful endeavors. They have been selected to illustrate four very different approaches to materials reuse, and our brief case studies examine how their respective benefits and challenges are relevant for Newark.

Policy Approach – Zero Waste Program (San Francisco, CA)

Overview

San Francisco's Zero Waste Program, dating from 1989, diverts more than 80% of the City's waste from landfills and incineration and has a goal of diverting 100% by 2020 (SF Department of Environment, 2012). The City develops its many waste diversion policies to achieve both environmental and economic goals, claiming that recycling, composting, and remanufacturing products employs 10 times more workers than sending them to landfill (Bell, 2012). Initiatives are structured to follow a waste reduction hierarchy, prioritizing waste reduction, then reuse, and finally recycling and compost. The City relies on a variety of creative approaches to waste reduction and management, including:

Legal framework – A Mandatory Recycling and Composting Ordinance requires that residents and businesses separate recyclables, compostable waste, and landfill trash. The ordinance incentivizes waste reduction by lowering hauling charges for residents and businesses that send smaller volumes of waste to landfills. A Construction and Demolition Ordinance ensures that all construction and demolition debris materials are properly recycled or reused.

Public Awareness Campaigns – The City routinely organizes campaigns to educate consumers about the environmental costs and consequences of their lifestyles. It has given out free reusable shopping bags, distributed a stop junk mail kit, and provided information to businesses on strategies for reducing waste in production cycles.

City Online Materials Reuse System – Surplus city-owned property is submitted to a virtual warehouse, where City agencies are encouraged to look for free items before buying new. The online materials reuse system has reused and recycled more than 720 tons furniture, supplies, and equipment worth more than $6 million.

City Role

A fundamental piece of the City's policy approach to waste reduction and reuse is its partnership with Recology, an employee-owned company and San Francisco's sole waste hauler (San Francisco Department of the Environment). Recology is a unique waste hauler in that its mission is focused on resource recovery, rather than just simply managing waste, the industry standard for most garbage haulers. It provides collection, recycling, compost, and disposal services, with an emphasis on developing programs and technologies that reduce the amount of materials sent to incineration. Its Artist in Residence Program provides artists with access to discarded materials, a stipend, and a work space, encouraging them to conserve natural resources and promote new ways of thinking about art and the environment (Recology, 2013).

Takeaways

San Francisco's success in implementing a comprehensive citywide waste reduction and reuse initiative is greatly facilitated by its collaboration with a private trash hauler whose mission is aligned with the City's. Further research should investigate implementation challenges associated with Zero Waste programs, in particular as they affect small manufacturers and business owners, as well as the cost savings and economic development impacts of the City's policy initiatives.

Salvage and Retail – Urban Ore (Berkeley, CA)

Overview

Urban Ore is a for-profit salvage and retail operation in Berkeley, CA whose mission is to "end the age of waste." Founded in the 1980s in response to resident and municipal interest in a waste diversion and reuse enterprise, the company first rented a 66,000 square foot property adjacent to the city's new solid waste transfer station to intercept salvageable materials before they reached the tipping floor. These materials were then cleaned, dismantled, and resold from an office space on-site (Urban Ore, 2013). The company has since greatly expanded its scale and scope of services since inception, and after several moves, operates from its more retail-friendly Ecopark Store location. Sited on 3 acres, the 30,000 square foot Ecopark warehouse and outdoor sales floor are open 7 days a week, 360 days a year. Urban Ore's current activities include the following:

Onsite Materials Recovery & Resale – Most household items, raw materials, and building materials can be donated to the Ecopark warehouse and are resold from the General Store and Building Materials Exchange (both sited at the Ecopark location). Urban Ore also picks up certain items and will occasionally pay a small fee for desirable materials and goods. Other items, such as some large appliances and electronics, carry a small fee for donation.

Offsite Materials Salvage – Urban Ore employs a salvage crew to scavenge reusable materials from transfer stations and landfills (made possible by the company's continued salvage contract with the City). These materials are also resold at the Ecopark Store.

Consulting – To expand its impact geographically, Urban Ore consults domestically and internationally on the design of resource recovery facilities and on materials salvage and reuse strategies more broadly.

(Reuse Development Organization)

City Role

The City of Berkeley has played a significant role in Urban Ore's formation and subsistence. It contracted with the company to salvage its waste, granting it licensed access to the scrap metals and reusable items that arrived at the waste transfer station. The City also provided Urban Ore's first resale location rent-free, with the agreement that it would remain so until the company began generating $11,000 in monthly income. After sales reached this point, the company paid rent as a percentage of sales over $11,000. Urban Ore chose to leave the City-owned space in 1989, but maintained its contractor role and has continued to benefit from the City's fiscal support.

Takeaways

Urban Ore represents a successful for-profit waste diversion enterprise whose core profit comes from salvaging and reselling materials otherwise headed to landfill. The City's incubation and continued partnership have been critical to this success. The company also benefits from a multi-pronged salvage approach: it captures household, commercial, and building materials waste streams, and operates both through donation and active scavenging. Despite the City's support and a solid business model, access to reliable, affordable warehouse and sales space has been a consistent challenge (as is common for many salvage/retail operations). Urban Ore believes it has surmounted this challenge in now owning its own facility, and has attempted to strengthen its Ecopark site and the Bay Area reuse ecosystem by attracting complementary businesses as tenants. This concept of co-location is also emphasized in its reuse facility design consulting. Further research should seek to better understand how Urban Ore sources manufacturing discards for resale, the details of its construction and demolition waste recovery activities, and the pay range and working conditions for different types of jobs within the company.

Industrial Symbiosis – Industrial Ecosystem Development Project (Research Triangle, NC)

Overview

The Triangle J Council of Governments, a regional planning organization in North Carolina's Region J, promotes collaboration among local governments, stakeholders and partners, to tackle development and infrastructure, economic development, energy and environment, and water resource challenges across the region (Triangle J Council of Governments). It has spearheaded ongoing by-product synergy and waste reduction initiatives, including an Industrial Ecosystem Development Project funded primarily by a grant for $162,888 from the United States Environmental Protection Agency (Kincaid, 1999). From June 1997 to May 1999, this regional project surveyed 182 businesses, developed an inventory of their inputs and outputs, and identified opportunities for local exchanges of byproducts. Relevant components include:

Methodology – The survey methodology included an on-site interview to generate ideas, as well as a traditional survey instrument. Businesses received a list of potentially reusable materials, from which they identified inputs and outputs from their own production processes. As businesses responded, researchers updated GIS maps showing the locations of discarded materials. These maps served as an engagement tool and a source of information for new interviewees, whose interest in the project often increased upon seeing the types of materials available within a particular radius of their operations. Although 53% of targeted businesses completed the survey, some expressed disinterest in the project due to time constraints or pre-existing beliefs that they did not have relevant inputs or by-products (Kincaid, 2001).

Partnerships – The project methodology was developed and executed in partnership with four universities, six local economic development organizations, and the state pollution prevention agency. In addition, a group of representatives from ten local industries advised on the best method of approaching industries and gathering information (Kincaid, 2001).

Results – Experts identified potential "matches" for about 48% of the responding businesses (Kincaid, 1999). The project ultimately resulted in the exchange of 49 different materials, including wood, plastics, metals fabric, fiberglass, and a variety of chemicals. Some of these partnerships were expected to generate significant financial benefits for participants, with one firm estimating its anticipated annual cost savings at $100,000 (Kincaid, 1999). However, a later analysis suggested that the project's environmental benefits from waste diversion were ultimately more significant than the economic gains. (Kincaid, 2001)

Industrial Symbiosis (Continued)

Council Role

In addition to initiating and managing the Industrial Ecosystem Development Project, the Triangle J Council continues to engage businesses in waste reduction projects. During the 2012 Triangle Green Business Challenge, fifty-two businesses of varying sizes participated in a competition aimed at improving the sustainability of their day-to-day operations. The challenge encouraged businesses to reduce waste, increase energy efficiency, make greener consumption choices, and provide environmentally friendly commuter choices. (Triangle J Council of Governments; Green Plus).

Takeaways

This case study illustrates how by-product and information exchanges may promote mutually beneficial business relationships across a broader region. The geographic reach of this project may have been an important determinant of the number of durable byproduct exchanges identified. The Triangle J Council's success in capturing the expertise of many local agencies, its consultation of industry experts, and its ongoing strategies for engaging businesses in waste reduction efforts may have also contributed to the project's success. Further research should investigate the project's long-term results, the logistics of creating partnerships between businesses, and the capacity and financial requirements that make such partnerships feasible for manufacturers.

Recycling/Reuse Business – TerraCycle (Trenton, NJ)

Overview

TerraCycle is a Trenton-based for-profit company that upcycles and recycles previously non-recyclable or hard-to-recycle waste into new products. The business partners with major corporations, community-based institutions, and individuals to run collections programs that capture post-consumer and post-industrial waste. TerraCycle's in-house R&D teams develop products that can be made with these waste streams and sold by major retailers. Founded in 2003 as a worm compost startup, the business now has more than 100 full-time employees and works with corporations such as Kraft Foods, PepsiCo, and Colgate-Palmolive. By 2012, TerraCycle had diverted more than 2.5 billion pieces of waste from landfills and engaged more than 40 million individuals in its worldwide collections programs. The company has two distinct means of product generation:

Upcycling – *Reusing discarded items in their original form to create a new product*

When possible, TerraCycle creates products with intact waste. This method typically requires the least amount of processing and energy. Examples of upcycled products include wallets and tote bags made from stitched-together plastic drink pouches, chip bags, and other wrapper-like materials; picture frames and coasters made from bicycle chains or circuit boards; and purses made from aluminum soda can pull-tabs.

Recycling – *Processing discarded items to create new products*

Some of the waste TerraCycle collects is better suited to reprocessing into a raw material that can be used to create a range of new products. Plastic discards, for instance, can be reprocessed into plastic pellets of various compositions to be used in injection molding, compression molding, and other manufacturing techniques. The products that can be made with these recycled materials are virtually limitless: TerraCycle makes everything from teething rings and watering cans to plastic lumber (the latter from the same juice pouches that are upcycled into wallets). A recent initiative recycles cigarette butts into plastic pellets that are used to make shipping pallets and other industrial products. The company can also formulate raw materials to another manufacturer's specifications.

Recycling/Reuse Business (Continued)

Corporation Role

Corporate relationships have been essential to TerraCycle's success and ability to expand. These major multinational producers of consumer goods pay the company to manage collections of their non-recyclable products and packaging, covering shipping costs to transport the materials to TerraCycle warehouses and typically a small per-item donation to a specified charity. TerraCycle also collects some of the corporations' shipping and manufacturing waste directly. The corporations benefit from positive press and image-building associated with these zero-waste activities. TerraCycle gains a massive, reliable, and affordable stream of inputs to generate products that can be sold at major retailers such as WalMart and Target.

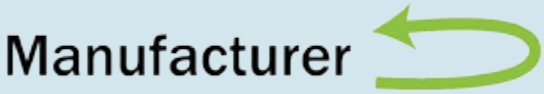
Takeaways

Strong corporate partnerships and marketing strategy have helped TerraCycle in its ever-expanding efforts to "eliminate the idea of waste." This case study, however, is applicable more broadly as a profitable upcycling and recycling business that relies on otherwise discarded waste streams as its inputs. Upcycling potential is clearly constrained by the ability to access large quantities of intact discards with sufficient frequency to support regular production of upcycled items. Without the powerful corporate connections and geographic reach that TerraCycle commands, it is unlikely that an upcycling enterprise can generate significant job creation. The reprocessing inherent in TerraCycle's recycling operations requires considerably less waste stream consistency, so long as there is a sufficient pool of discards to collectively generate a raw material. Even recycling, though, will likely demand sourcing from a fairly broad base (be it a large region or multiple sectors within a smaller geography) if the goal is a significant remanufacturing operation or production of recycled materials for distribution to other manufacturers. Further research should investigate TerraCycle's plastics recycling process, including its costs, profitability, equipment requirements, and number of associated jobs, in order to gain a better understanding of this business model's potential and limitations in the Newark context.

MODELS FOR INDUSTRIAL MATERIALS REUSE

The above case studies illustrate the wide range of current materials reuse practices. In order to classify and compare these practices, we identified six different theoretical models for industrial materials reuse. These categories are not mutually exclusive, and most practical examples do not fall neatly into a single one. Instead, many combinations and hybrids are possible. TerraCycle, for instance, functions as both a new reuse business and a processing facility. Nonetheless, this typology provides a helpful framework for understanding different types of reuse activities. Below, we briefly define and explain each model.

Internal Manufacturer Reuse



Some high-capacity manufacturers absorb their own byproducts in different parts of their own production processes. This may result in significant cost savings for these manufacturing firms, which may also benefit from branding and marketing themselves as "green" enterprises. This model is most easily implemented when manufacturers have consistent byproduct streams and diversified product lines, as well as significant self-evaluation and research and development capacity that allows them to identify opportunities for byproduct reuse.

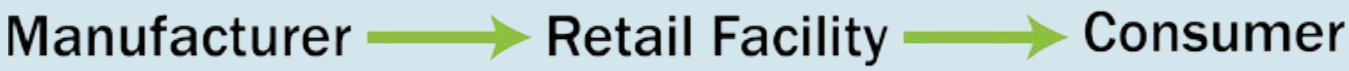
Manufacturer-to-Manufacturer Byproduct Exchange

Although the diagram above depicts a single transfer between two manufacturers, this model also encompasses large networks of manufacturer-to-manufacturer byproduct synergies, as seen in industrial ecosystem development projects. As the Research Triangle case study illustrates, such networks are often most successful at a regional scale, where a larger number of participating firms means greater potential for productive matches. A City, potentially alongside expert consultants, might play a crucial up-front role in identifying and facilitating partnerships, but its ongoing involvement would likely be minimal. In order for this model to be sustainable, manufacturers must have the capacity to privately transport and process others' discards for reuse as inputs.

Conventional Industrial Recycling

Where manufacturers throw away traditional recyclables such as cardboard, plastic, and glass, a straightforward recycling model may generate environmental benefits through waste diversion. Recycling might also be encouraged through a range of municipal regulatory incentives, such as those discussed from San Francisco.

Byproduct Warehouse or Retail Facility

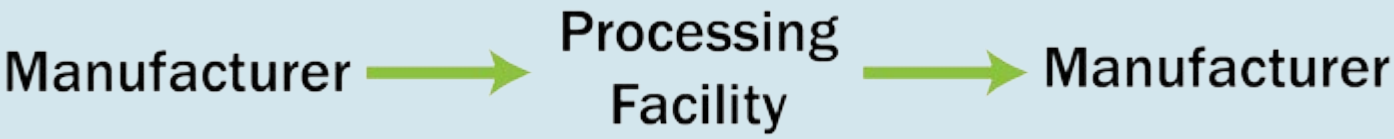


This model distinguishes itself from the previous three by the introduction of an intermediate step between the manufacturer and the end user of its byproducts, taking pressure off of the manufacturer to internally manage these transactions. A City, a private actor, or a nonprofit organization might warehouse byproducts and develop a retail facility to resell these discards to individuals and organizations. End users could range from cost-motivated small business owners to arts, culture, and education organizations. As illustrated by the Urban Ore example, this model depends on reliable warehouse space (of sufficient size and appropriate location), continued consumer demand for the materials housed, and an ongoing staffing and overhead commitment in the intermediate step.

New Reuse Business

Many reuse businesses rely on manufacturer discards to develop and sell new finished products. This model distinguishes itself from the second model (a byproduct exchange between existing manufacturers) in its emphasis on creating brand-new profit-generating enterprises, whose missions and product lines are explicitly oriented toward reuse. Depending on the scale and nature of their production, reuse businesses may require a certain volume, consistency, or uniformity of the byproducts that they use as inputs. A City might play a role in incubating new reuse businesses, allowing them to more easily access space, equipment, and technical support.

Byproduct Processing Facility



Recognizing that in some cases, it may not be feasible for end users (including existing manufacturers, reuse businesses, and other consumers) to reuse discarded materials in their current state, this model relies on an intermediate processing facility to reconstitute them into inputs appropriate for manufacturing. Such a processing facility could be City-run or City-incubated. This model may be more appropriate for some raw commodities than others, since demand for recycled inputs will he highest when pricing for the corresponding virgin materials is high. Like many others, this model also depends on consumer willingness to purchase products made with recycled materials.

MATERIALS REUSE IN NEWARK

In our initial assessment of which reuse models and activities might be most appropriate for the City of Newark, we took into account a number of Newark-specific factors. First, we drew on our understanding of the City's vision, resources, and desired involvement with the project. Because the City identifies job generation as its primary goal, we recommend that it prioritize reuse activities with the high proven job creation benefits over volunteer-driven strategies. The City has the capacity to be involved with the program on an ongoing basis, and to play a role in program management, including but not limited to: picking up waste, housing materials in City-owned warehouse space, updating an exchange website, incubating small businesses, or coordinating regulation with larger jurisdictions and landfills.

Second, we took into account our initial findings about Newark's manufacturing sector. Because manufacturing firms in Newark are small and often produce single pieces of a supply chain rather than final products, it seems unlikely that they would be able to discover new opportunities to reuse their own byproducts. Moreover, they may have extremely limited capacity to cost-effectively house, transport, or process other firms' discarded materials for their own use. Although an online platform could be used to facilitate exchanges for a number of reuse activities, it is also important to bear in mind that capacity issues may limit how frequently manufacturers are able to update such a site.

Further investigation is needed to confirm our preliminary assumptions about the types and volumes of materials that manufacturers discard. However, our initial site visits suggest that the industrial waste stream in Newark is relatively small, that it is comprised primarily of small scraps rather than intact materials, and that the nature and number of discards may vary for each manufacturer depending on seasonal and contract orders. One exception may be shipping materials, including cardboard boxes and wooden pallets, which were present in large quantities at both manufacturing businesses we visited in Fall 2013 and may represent a more consistent discard stream across firms. Low-volume, variable waste streams present a number of challenges for a reuse program. For instance, new reuse businesses may falter if they are unable to source consistent inputs from reliable discard streams, while a retail facility may not generate sufficient demand for the small scraps that Newark manufacturers produce. For this reason, depending on its ultimate choice of a reuse program, the City may wish to consider expanding the scope of its project to include other waste streams in addition to byproducts and shipping materials discarded by Newark manufacturers. Co-locating several different types of activities may also allow for some flexibility, allowing the City to direct each discarded material into its highest and best use depending on shifting market pricing, job generation potential, or other criteria.

EVALUATING REUSE PROGRAMS

Drawing on our research into existing materials reuse activities as well as our initial analysis of Newark-specific advantages and limitations, we developed a list of potential considerations that might inform the City's strategy for a materials reuse program. This framework, entitled "Reuse Program Evaluation Criteria," is intended as a practical tool to help the City explicitly identify and weigh the potential benefits and challenges of any particular materials reuse activity under scrutiny. Its questions are intended to guide decision making both in the early phases of program conceptualization and on an ongoing basis throughout program development. We group our questions into five distinct areas of evaluation: (1) Job Creation and Economic Development, (2) Waste Diversion and Environmental Impact, (3) Benefits and Costs to Manufacturers, (4) Requirements for Discarded Materials, and (5) City Involvement and Resource Requirements.

REUSE PROGRAM EVALUATION CRITERIA

Job Creation & Economic Development Impact

How many jobs will this reuse program create?

What kinds of jobs will be created (including but not limited to: hauling, processing, sorting, retail, disassembly, production, reassembly, research & development, product inspection)?

How many new jobs will be for City employees? How many will be private-sector jobs?

What wages are associated with these jobs?

What occupational hazards are associated with these jobs?

Are they part-time, full-time, or seasonal jobs?

Are these jobs accessible to the local workforce?

Will this program incentivize or incubate new manufacturing businesses?

Waste Diversion & Environmental Impact

What volume of discards will this reuse model divert from landfill and incineration?

Does the model require substantial transportation of materials? Will it generate substantial traffic or pollution from hauling?

Will end user activities (such as remanufacturing businesses) generate any harmful environmental impacts?

Benefits & Costs to Manufacturers

Will this program generate savings in hauling costs for existing manufacturers?

Will this program provide existing manufacturers with new, cheaper inputs for their production process? Will it require them to process or treat discarded materials before reusing them in production?

Will this program promote useful partnerships between existing manufacturers?

Will this program help existing manufacturers to make their production processes more efficient or sustainable?

Will this program require ongoing time investments from manufacturers (including but not limited to: time spent updating a website, time spent sorting discards)?

Will this program require manufacturers to provide additional space to house materials awaiting reuse?

Will this program require manufacturers to transport any materials for exchange?

Requirements for Discarded Materials

Will the program work best with a greater volume of inputs? Are there benefits to expanding the waste stream in terms of geography, or sourcing non-manufacturer waste?

Will the program require a consistent volume of inputs?

Will the program require inputs to be uniform (in shape, size, color, or other characteristics)?

Will the program work best with small scraps or with intact materials?

How high is market demand/pricing for the materials to be reused?

City Involvement and Resource Requirements

What up-front and ongoing financial investment will this model require?

Will the City need to rent or purchase a space?

Will the City need to facilitate materials transportation?

Will the City be involved in ongoing program management?

Will the City be involved in identifying markets or institutional buyers for reused products?

Will the City be involved in creating exchanges or partnerships between existing manufacturers?

Will the City be involved in incubating small businesses? Will it provide space, equipment, or other expertise?

Will the City use any regulatory incentives to promote waste diversion?

PART II

PROPOSED SPRING 2014 STUDIO ACTIVITIES

OBJECTIVES & METHODOLOGY

Based on the preliminary research discussed thus far—comprised of a literature review, case studies, meetings with a range of experts, and initial site visits to manufacturing firms—we have developed further research objectives and a plan to achieve them through the Spring 2014 Community Development Studio. With an understanding of the different reuse programs the Office of Sustainability might consider and the criteria necessary to evaluate the appropriateness of each, we must next gather more information about Newark's current manufacturing discards and waste removal activities to help inform the City's evaluation process. To complement these findings, we will research opportunities to expand the ultimate program waste stream beyond Newark's manufacturing discards, and will further investigate existing reuse businesses and initiatives. This section of the report includes an explanation of our objectives and plan for accomplishing them.

To inform the City's development of an industrial reuse program, our primary objectives for Spring 2014 will be:

1. **Learn about Newark manufacturing firms' discarded durable materials and waste removal processes**
2. **Gather Newark manufacturers' feedback on potential reuse programs, including perceived benefits and challenges**
3. **Explore opportunities for expanding a reuse program's inputs beyond Newark's manufacturing discards, potentially incorporating additional waste streams**
4. **Further investigate existing reuse programs**

To meet these objectives, we will conduct site visits to manufacturing firms, expand our case study research, and continue our consultation with industry and academic experts.

MANUFACTURER SITE VISITS

Based on our Fall 2013 research, we believe the best way to approach the first two objectives is through site visits to Newark manufacturing facilities. However, several other methodologies were considered. A survey instrument, for instance, is less time-intensive and offers the potential to reach a greater number of manufacturers. We ultimately dismissed a traditional paper survey based on the low rate of return yielded in a survey of manufacturers conducted for the recent Brookings Institute report (Mistry, 2013). Further, the information gained through a survey is not likely to be comprehensive enough to meet our objectives, nor adaptable enough to suit the wide range of manufacturing business types in Newark. The site visit method allows the studio team to retrieve extensive and detailed information, clearly communicate the City's goals, and tailor questions as appropriate. Additionally, this approach allows for photography of discards and waste removal infrastructure, which adds a visual storytelling element to the documentation process and helps minimize lost information.

Our goal is to conduct semi-formal interviews, lasting approximately 30 minutes in length, with 25 to 30 Newark-based manufacturing businesses between February and April 2014. To the extent possible, interviews will be conducted at the firm's manufacturing facilities, with one or more representatives of the firm. Representatives should be business owners or employees with knowledge of the firm's durable byproducts and waste removal processes, and would ideally be able to discuss the implications of a reuse program for the company. Two to three members of the Spring 2014 Community Development Studio team will be present for each interview, and will conduct written and photographic documentation. These team members will be trained by members of the Fall 2013 studio in preparation for site visits, and will use the Interview Guide we have designed to facilitate these interactions (see Appendix). The types of questions and other information gathering strategies outlined in this guide are discussed further in the following section, along with documentation methods.

Recruitment of businesses for participation in this project will first be driven by the personal suggestions of Newark-based experts with whom we've spoken this semester. Subsequent outreach will be conducted through the Made in Newark network of local manufacturing businesses, and then supplemented with recommendations from past interviewees as the research progresses. The businesses interviewed will represent a broad sample of the city of Newark's manufacturing sector with regard to firm size and subsector.

Components & Implications

The questions outlined in the site visit Interview Guide are divided into three sections: 1) Durable materials the businesses currently discard; 2) The businesses' waste removal process and associated costs; and 3) Manufacturer feedback on the benefits and challenges of reuse. Below, we briefly discuss the types of information that will be gathered for each of these site visit components, and the potential implications of the findings.

Durable Materials Currently Discarded

A comprehensive understanding of manufacturers' discarded byproducts reveals the inputs that the manufacturing sector offers a potential reuse program. Our classification of theoretical reuse models and criteria for program evaluation, discussed in Part I, illustrate how certain approaches, such as manufacturer-to-manufacturer exchange or a new reuse business, will likely require a substantial and reliable volume of byproduct inputs, or may necessitate uniform, intact discards. A recycling business or processing plant may not require the same consistency, but will need byproducts of particular raw material types (glass, plastic, etc.) and will likely have similar volume

thresholds. A warehousing retail approach does not carry these same demands with regard to byproducts, but introduces other constraints, including space needs and lower job creation potential. Thus, our site visit teams will take detailed notes on the material type, form, volume, frequency, uniformity, and various other characteristics of every durable byproduct and shipping/packaging material manufacturers currently discard.

Waste Removal Process & Costs

Questions in this section will help determine the feasibility and logistics of separating salvageable waste materials from unproductive discards. In investigating a byproduct's path from the production process to the dumpster, we can identify whether and at what point it mixes with other waste, and determine the degree to which such mixing "contaminates" the material or otherwise complicates its salvaging for reuse. Information about the path and potential extraction of byproducts has several implications for evaluating reuse models. For instance, a business that sends otherwise reusable plastic discards to a waste bin containing organic wastes may compromise the quality and reuse potential of the plastic byproducts. This information could simply indicate that these byproducts are no longer an ideal input for a reuse program, or might suggest the need for a City program to incorporate a material-specific container at all firms supplying discards. As outlined in the Interview Guide, site visit teams will also inquire about each firm's waste hauler and associated contract. Information gathered will include the identity of the hauler, how often waste is collected and from where, the fee structure of this contract (does the hauler charge by the visit, by volume, or have a flat fee, etc.). While it seems unlikely that Newark will be able to introduce a single-hauler system as San Francisco has done with Recology, a better understanding of the industrial waste collection landscape could nonetheless inform potential reuse strategies and hauling partnerships.

Manufacturer Feedback

Manufacturer insights into potential reuse activities will inform program development around the City's third goal, strengthening Newark's existing manufacturing sector. Clearly, a program that leads to cost savings for the firms would be well received, but more information is needed to identify strategies that would truly cut manufacturers' costs. For instance, our initial visit to ZaGO revealed that waste diversion would not necessarily yield lower hauling costs for the company. Even if salvageable byproducts were removed from ZaGO's waste stream, a hauler would still have to be paid the same flat fee to make weekly pickups of organic and other non-diverted discards. As outlined in the Interview Guide, site visit teams will ask a range of questions to determine if there might be other opportunities for cost efficiencies through reuse. Learning about firms' input sourcing, for example, might reveal a number of manufacturers that work with rubber and could benefit from a new business that produces recycled rubber and sells it for less than the cost of virgin material. Other value-add opportunities could be related to competitive marketing advantage. We would like to know whether firms think they could win more business if they were identified as a sustainable or zero-waste company by participating in a reuse program. In addition to informing strategies that would incentivize program participation amongst manufacturers, this final component also concerns factors that would restrict firms' participation. For instance, as the majority of Newark's manufacturers are small local businesses, we imagine most will have limited time and staff resources to dedicate to a reuse program, no matter how eager they are to participate. Questions in this final section will also address firms' broader operating challenges, as a more global understanding of the sector's collective business constraints will inform responsible program design.

Site Visit Documentation

Studio team members will record and communicate their site visit findings in two ways. Site Visit Review Documents will provide narrative summaries of each visit and interview, and a Manufacturer Database will more comprehensively record information for detailed review and analysis. Both products are outlined below.

Site Visit Review Documents

Qualitative site visit review documents will be created for all firms visited. Structured to provide a snapshot of each business's manufacturing process, discards, waste removal details, and feedback on a potential reuse program, these documents will summarize site visit teams' detailed notes. Photographs, taken with manufacturers' permissions, will be included to help illustrate each manufacturer's "story." A template will ease this documentation process and standardize the final products. These documents are meant to record site visit findings for the Office of Sustainability, but could additionally be shared with potential end users of manufacturer discards, or used for publicity purposes (for either the program or for individual businesses).

Manufacturer Database

Site visit findings will also be documented in a relational database, which will include tables cataloguing general firm information and site visit details; all durable materials discarded; and firms' waste removal details. The first table will include firm address and contacts, site visit date and team members in attendance, and a general classification of the firm type (by SIC industry code or a similar sector identifier). The second table will include an entry for every discard identified, with an item description and associated fields to record various characteristics. For instance, the discard will be identified as a byproduct or a shipping material, and will be assigned a raw material type based on Urban Ore's categorization of waste materials. This table also includes fields to record the frequency at which each discard is generated, the volume discarded, and the degree to which that volume varies (custom orders, for instance, often produce variation in the amount of discards a firm produces). An initial version of this discards inventory table can be found below. The third table will identify each business's private waste hauler and record waste management info including the frequency of waste pickups, total hauling costs, and billing structure (flat fee, by volume, etc.).

MFG	ITEM DESCRIPTION	CLASS	RAW MAT	FREQ	VOLUME	VAR
ZaGO	Stainless steel scraps: Curly shavings, shortened ends of screws	Byproduct	Metals	Monthly	1.5 barrels	Highly Variable
ZaGO	Metal drums	Shipping Material	Metals	Sporadic	1 in several m	Highly Variable
Unionwear	Corrugated Cardboard Boxes	Shipping Material	Paper	Weekly	1 cart	Some Variation
Unionwear	Paper scraps from cut-out sewing patterns	Byproduct	Paper	Weekly	Small?	Constant
ZaGO	Corrugated Cardboard Boxes	Shipping Material	Paper	Unknown	Unknown	Unknown
ZaGO	Polyurethane and resin mix shavings ("sawdust")	Byproduct	Polymers	Unknown	Unknown	Some Variation
ZaGO	Rubber: shavings and larger pieces with extracted patterns	Byproduct	Polymers	Daily	30-32 rubber	Highly Variable
ZaGO	Office furniture: chairs, drawers, filing cabinets	Other	Reusable Goods	One-time	Unknown	Not Applicable
Unionwear	Cotton & synthetic fabric scraps, leather scra	Byproduct	Textiles	Weekly	1-2 carts	Constant
Unionwear	Shipping pallets	Shipping Material	Wood	Weekly	25 pallets	Constant
ZaGO	Sample moldings carved from wood	Byproduct	Wood	Unknown	Years' worth (	Unknown
ZaGO	Shipping pallets	Shipping Material	Wood	Unknown	Unknown	Unknown

Discrete tables within the database will share a common manufacturer variable, which allows them to be linked. The database will be sortable to easily identify trends (common raw materials amongst discards, frequently used hauling companies, etc.). To the extent possible, standard values and measures will be used streamline analysis and maximize comparison of discards. However, further research is necessary to identify strategies for reporting certain characteristics, such as discard volume, which proved difficult to both assess and standardize during our initial site visits. The database will use a simple, user-friendly spreadsheet structure, and can be managed by the Office Sustainability after the Spring 2014 studio. In addition to serving as a comprehensive record of site visit findings and tool for their analysis, this database could become the skeleton of an online inventory or exchange platform to support the City's ultimate reuse program.

ADDITIONAL RESEARCH

To address objectives three and four, the studio team will pursue additional research activities while manufacturer site visits are being conducted. Our proposed directions for further investigation are discussed below.

Because our preliminary research suggests that the range of possible approaches to materials reuse in Newark may be quite limited if the program captures only the city's industrial discards, we suggest the Spring 2014 studio investigate avenues for expansion of that waste stream. For the purposes of this investigation, we define a waste stream by both the sector from which discards are generated and the geographic scope of waste collected. Thus, one component of this research will explore the potential benefits of incorporating residential, commercial, and/or construction and demolition waste in a reuse program, as well as the logistics associated with such an expansion. Urban Ore, for instance, relies heavily on donated household items and building materials for its successful retail operation. A second component of this research will examine potential benefits and logistics of broadening the waste stream by sourcing from geographies larger than the City of Newark. This could simply mean collecting discards from neighboring municipalities as well as from Newark; or operating on a larger regional scale (perhaps Essex County or several Northern New Jersey counties), as was effective in Research Triangle's byproduct exchange program. A reuse program could also be structured around the discards that come through one of Newark's waste transfer centers, such as Doremus Avenue Recycling and Transfer Station (DART), a rail-serviced transfer station that serves as the flow point for much of Metro New York City's and Northern New Jersey's municipal solid waste and construction and demolition debris (EnviroSolutions Inc.).

We also propose continued investigation of successful reuse activities that meet some or all of the City's program goals. This could entail expansion of some of the case studies, per our recommendations above or other City interests, and of course should include additional programs as well. One category for this research might concern for-profit reuse and recycling businesses. While the studio team's primary task is concerned with the supply side of the City's ultimate reuse program, a better understanding of the potential business demand for discarded materials could be very helpful in crafting a viable approach. As our preliminary research revealed, businesses on the user end of a reuse program could range widely in scale and activity, from small, artisan design businesses (such as jewelers or boutique furniture makers); to salvage and retail operations; to deconstruction enterprises that remanufacture shipping pallets or mattresses; to waste management and resource recovery operations; to larger scale manufacturers that can create products from intact or recycled discards. Research would focus on the

overall business model and employment potential as well as any roles that a City or other public sector entity has played in companies' incubation or ongoing operations. A second proposed research category concerns regulatory approaches that encourage materials reuse. An expanded scan of municipal Zero Waste policies—particularly those that include industrial waste—could suggest possible initiatives the City could establish to support a reuse program. Our Fall 2013 studio has also uncovered several specific regulatory approaches that should be further explored, such as Urban Ore's status as a contracted salvage operator with the City of Berkeley, and California's statewide Recycling Market Development Zones (RMDZ), which are used to fuel economic development by offering attractive business loans, technical assistance, and free product marketing for businesses that divert materials from the waste stream and locate in the specified zones (CalRecycle).

CONCLUSION

We hope that our review of the current waste diversion and reuse landscape helps to both inspire and focus the Office of Sustainability's vision for a reuse program in Newark. There are many significant takeaways from this first semester of research, including the importance of discarded materials' consistency, volume, and other characteristics; the differing job quality and business viability implications of retail versus recycling or reuse; the need to plan around limited manufacturer resources; and the significance of determining what role the City will play in incubating or operating a reuse program. However, this discussion necessarily prompts more questions than answers. Now with a clearer understanding of what these questions should be, the full Spring 2014 studio team can launch a thorough, focused exploration of the potential for a materials reuse program in Newark.

A broadening of the initial project scope seems essential to developing a successful reuse program in Newark. Thus, as discussed above, we plan to conduct research to complement site visit findings on Newark manufacturers' discards, waste removal processes, and feedback on a potential reuse program. We have outlined potential directions for this investigation, which concern both waste stream expansion opportunities and more in-depth case study research into reuse business models and regulation. Input from the Office of Sustainability will help to prioritize and direct these additional research activities so that the information gathered can best support the City's program development process.

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APPENDIX

Guide for Manufacturer Site Visits

Objectives

Gain as comprehensive as possible an understanding of:

- The manufacturer's durable byproducts (type, volume, frequency of production)
- The manufacturer's waste removal processes and costs
- The manufacturer's interest in a reuse program (incentives, challenges, feedback)

Introduction

We are graduate students at Rutgers' Bloustein School of Planning and Public Policy. We are working with the City's Department of Sustainability to investigate the durable byproducts and other materials that Newark manufacturers discard. The city would like to support manufacturers by redirecting some of their waste away from landfills and into a reuse program, hopefully generating cost savings and increased efficiency through minimized waste removal needs. The goal is that these discards be reused as raw products by other manufacturers, and that more manufacturing jobs and businesses will be created as a result.

We've come to visit you because we would like to:

- Better understand your manufacturing process, the durable byproducts that you generate, and what you do with them;
- Gauge your interest in a reuse program that would recycle manufacturing byproducts; and,
- Learn how the City might structure a reuse program to maximize your cost savings and other potential benefits.

Before beginning the interview, have the manufacturer read and sign the IRB consent form. Ask permission to take photos, prioritizing photos of byproducts and removal processes. Document photo permission in field notes.

Questions

Manufacturing Process, Byproducts, and Discards

- What products do you make?
- Can you walk us through your manufacturing process for these products?
    - What are the raw inputs? Where do they come from? In what packaging materials are they delivered?
    - Do you use any recycled materials in your production process?
    - Who are your buyers? How do their needs/preferences affect your production process?
- What are your byproducts?
    - Which byproducts do you generate regularly? Which are one-time or infrequent byproducts?
    - What volume of each byproduct do you typically discard? Are the volumes constant, or do they vary depending on your current orders (or something else)?

Waste Removal Processes and Costs

- Where do you store byproducts after the manufacturing process? How do you dispose of them?
  - Are different byproducts stored separately, or are they combined?
  - How often are byproducts taken to the dumpster?
  - Is there any chance of contamination, either between byproducts or by any other types of waste? Are byproducts exposed to food waste?
- How do you dispose of shipping and packaging materials?
- Who is your trash hauler?
  - How often does the hauler pick up waste?
  - Do you have a recycling hauler?
  - What are your typical monthly hauling costs? May we refer to a past bill to check the exact amount?
    - Are you charged by number of pick-ups or weight of discards?
    - Do you have a contract with the hauler? If so, what are its terms?
    - Are there fees for additional/unscheduled pickups or for items outside the dumpster?
- Do you currently have any donation/bartering practices in which you give away or trade any of your byproducts or discards with other manufacturers, organizations, or individuals?

Manufacturer Interest and Feedback

- What are your three biggest challenges as a firm? What, if any, are your biggest waste disposal challenges?
- What would make you most interested in participating in a reuse program?
- What are your biggest concerns about participating in a reuse program?
- Do you have space to temporarily store some of your byproducts for reuse?
- Would you be willing for the City (or another user) to pick up some of your byproducts for reuse?
  - How frequently would you need these byproducts to be picked up?
  - What are the best days/times for byproducts to be picked up?
  - Would you be willing to pay an additional small fee to have these items picked up?
- Would it be feasible for you to keep an updated list of your discards on an online platform, so that interested users could come and pick them up?
- Do you have any additional suggestions as to how a reuse program might work best for your manufacturing business?