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Building Materials Reuse Analysis

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01
Introduction

1.1 Project Summary

This project aims to rethink the commercial construction material reuse supply chain and retail market. Through research into the San Francisco commercial construction market, we estimate the potential size of the commercial construction material reuse market and the potential financial, environmental, and workforce development impacts of further developing this market. We then explore a model for developing a Material Reuse Center to facilitate the collection and reuse of commercial construction materials.

1
ANALYZE BUILDING MATERIAL REUSE SUPPLY CHAIN

We explore reuse strategies by mapping existing building material supply chain systems, and the potential systems that would address environmental goals, while building regional economic resilience and increasing ease of implementation.

Regionalizing material/product availability can reduce reliance on importing from volatile supply chains subject to disruptions. Our team has studied the current stream of building materials exiting the built environment, and characterized materials by:

- **VOLUME:** Total volume in the current commercial building stock that is anticipated to be deconstructed in the coming decade.
- **RECOVERABILITY:** Degree to which the material is typically readily recoverable in whole form from existing buildings, and resource/time-intensity of recovery.
- **ECONOMIC VALUE AND MARKET DEMAND:** Estimated price per unit of recoverable volume, and the current (or potential with intervention) industry demand.
- **ENVIRONMENTAL IMPACT**: Embodied energy savings and other benefits compared to sourcing corresponding newly manufactured products.

1.1 Project Summary

2
DESIGN AN ADAPTABLE AND REPOSITIONABLE MATERIAL REUSE FACILITY PROTOTYPE

We develop a conceptual design framework for the development of physical locations where products/materials are recovered and processed for additional economic value, including partnering with neighboring communities to create reuse facilities that serve the region.

The framework includes minimum requirements for the installation and operation of a reuse facility prototype specializing in commercial building products, designed for occasional disassembly and reconfiguration across various locations in the region to follow site availability and influx of construction activity, while requiring minimal infrastracture.

1.2 Project Context

Construction activities are responsible for more than 30% of resource use worldwide and 23% of global greenhouse gas emissions, most from material production. Despite the great cost and ongoing demand for building products, the majority of remnant, salvageable, and surplus items are landfilled or incinerated.

In San Francisco, building materials represent about half of all municipal solid waste and approximately a quarter of all discards. Reuse is an obvious strategy to address generation reduction and disposal to landfill, but infrastructure is necessary to bolster implementation. Indeed, few mechanisms exist to sustainably address building material disposal churn through cities. Discards include material that are recycled, composted, landfilled, and/or reused.

THE CONVENTIONAL APPROACH IS BINARY: ITEMS ARE EITHER NEW OR TRASH.

Embodied carbon is the sum impact of all the greenhouse gas emissions associated with a product throughout its lifecycle.

The embodied carbon of a building product is especially relevant in this age of climate action.

It is anticipated that embodied carbon will be responsible for more than 70% of the carbon emissions associated with global new construction between now and 2030.

right: The Ford Foundation Center for Social Justice, New York, by Gensler.
Over 20% of the materials were locally sourced to minimize resource consumption, and any furniture reused from the space were GREENGUARD certified.

San Francisco's 2021 Climate Action Plan includes a key strategy to achieve total carbon balance across the building sector. To that end, San Francisco Department of the Environment (SFE), StopWaste, and partners are working to advance a broad range of opportunities for circularity and embodied carbon reductions, with aims to improve the economy, embodied carbon performance, and housing outcomes throughout the region.

One effort that has significant potential is a Building Resources Innovation Center (BRIC), a pilot to develop a physical space for the temporary storage and redistribution of salvaged and surplus building products, which we explore further in Chapters 3 and 4 of this study. Advantages of this approach include:

- Developing a regional solution that reinvests in the local economy, reducing impacts from supply chain uncertainty and reducing transportation costs and related energy use.
- Providing materials storage space and an escrow model to smooth out lumpiness inherent in re-used commercial building material supply and helping align that with construction schedules.
- Adding resiliency to the existing global building product ecosystem by offering a local network node for material reuse collection and redistrubtion, extended the useful life of these products.
- Engaging the local community through building industry education programs, workforce development, and community partnerships.

The BRIC should be adaptable and repositionable, designed for disassembly to easily respond to market and community needs, with the ability to be relocated to a different site as the city and region's urban fabric evolves. With a concept that is easily replicable, and becomes more effective and efficient with scale, the BRIC will serve as a blueprint and invitation for other cities to implement an interconnected series of inverted hub-and-spoke structures throughout California, the country, and beyond.

1.2 Project Context

The Reuse Roadmap highlights the current construction material reuse process, which requires significant focused effort, coordination, and expertise. Developed through a Gensler Research Grant, this Roadmap provides a good framework on which the BRIC concept and design can build.
While the Reuse Roadmap considered numerous construction materials and products, including furniture, this project focuses on those projects with the biggest impact and biggest potential to scale.

THE REUSE ROADMAP

Things to Consider:

- Schedule
- Cost & budget
- Storage capacity
- Partnerships
- Design flexibility
- Manufacturer/recycling take back programs

START

Starting Questions:

- What are your demolition and waste stream lease requirements?
- What of the existing material inventory can be reused or repurposed within new space?
- Is there anything in the existing site that might reveal history of the building, previous tenant or neighborhood?
- Is there a resale market for deconstructed materials and products?
- As design evolves, what are the compromises the project team is willing to take?
- Are there fixed elements in the design that could be designed & detailed for disassembly?
- Can reused furniture be designated to certain areas, while using new furniture for higher impact moments?

1. Plan:

It is critical to start early and establish a game plan for reuse. Develop a 'Reuse Strategy' to serve as a guide. **Generate example timelines that specifically communicate the reuse commitment and expectations to the entire team,** regardless of the length of the project. Create 'toolkits' with specifications that project teams and designers will utilize.

2. Discover:

Keep a lookout for opportunities to reuse. Survey the existing project space (if applicable) and evaluate what could be reused/ deconstructed/ donated/ returned. **Get creative!** Use reclaimed materials as your palette and find new ways to put materials together.

3. Partner:

In order to transform the design process into an increasingly reuse-friendly, circular network, the development of reuse networks will thrive with the formation of partnerships. Look for deconstruction and reuse partners to help with the various steps needed to secure reclaimed materials; even if they aren't offering the service, ask them anyway! **The more they are queried about supplying reclaimed materials, the more likely they are to consider fulfilling that role.**

4. Consider:

Be flexible. Everyone loves to see a plan executed perfectly, but it's seldom a linear journey. Twists and turns occur at every step along the way. **Your job at this stage is to put on your "what if?" hat and think through some bumps in the road before you start driving.** It is very rare for reclaimed materials to precisely match your design. Being flexible in colors, finishes, and sizes will increase the likelihood of finding matching materials, while still being true to the overall goals of the project.

5. Vision:

Help the project team visualize reuse design opportunities alongside cost implications. You may have done some of this already, but now is the time to really **focus in.** What does the end-user really want? Now, what's the realistic vision? **DON'T over commit, know your limitations, and ALWAYS manage expectations.**

6. Perform:

Now is the time to start tapping into your industry network for reuse vendors and like-minded contractors. **Again, be sure you know exactly what you are asking for. Be specific.** Don't get discouraged if someone isn't able to help. Keep at it. Remember: there are a lot of companies out there that DO want to pitch in!

7. Deliver:

Identify and secure contracts for waste/reuse materials. Explore existing manufacturer/recycling take-back programs that would benefit from any unused resources. Coordinate with furniture vendor contractors to remove and recycle furniture. For items not being reused, reach out to other project teams and local non-profit organizations in need.

8. Communicate:

Congratulations! You've successfully implemented reuse on your project. Now, share your findings with others. What were the challenges and how did your team overcome the barriers? The reuse ecosystem will only grow faster by everyone sharing project stories and 'lessons learned' with their local communities.

9. Document:

Now is the time to organize your project materials. Wrap up the success of the project and design by tracking relative metrics. Track all waste streams and/or waste reduction. Provide carbon saving calculations. Now is also a good time to put together a short presentation chronicling the work and the 'reuse story' for future project teams to access.

REPEAT

Conclusion:

As you've undoubtedly realized, this is neither an exhaustive list nor a strict check-box-style "how-to" guide. Rather, it should serve as a general list of topics to consider when thinking about starting a reuse project. **This should get you headed in the right direction and help you consider what might come next.** You may not be able to go in this exact order, and you may not want to, but anticipate how you'll approach each of these steps, as they have been critical to complete in prior reuse projects.

From What's Old is New Again, Research Grant Project by Gensler.

1.2 Project Context

While commercial reuse is currently a relatively niche practice, there are significant examples of commercial reuse projects, following the principles and process illustrated in the reuse roadmap. The table below represents data from 10 commercial projects resulting in construction material salvage and reuse provided by The Reuse People (TRP), Deconstruction and ReUse Network (DRN), and Madrone Construction Resources.

The table includes materials and quantities that were actually salvaged, and redistributed from each project. Most of the materials that were recovered were donated to the community, with a small percentage being sold through TRP's retail store.

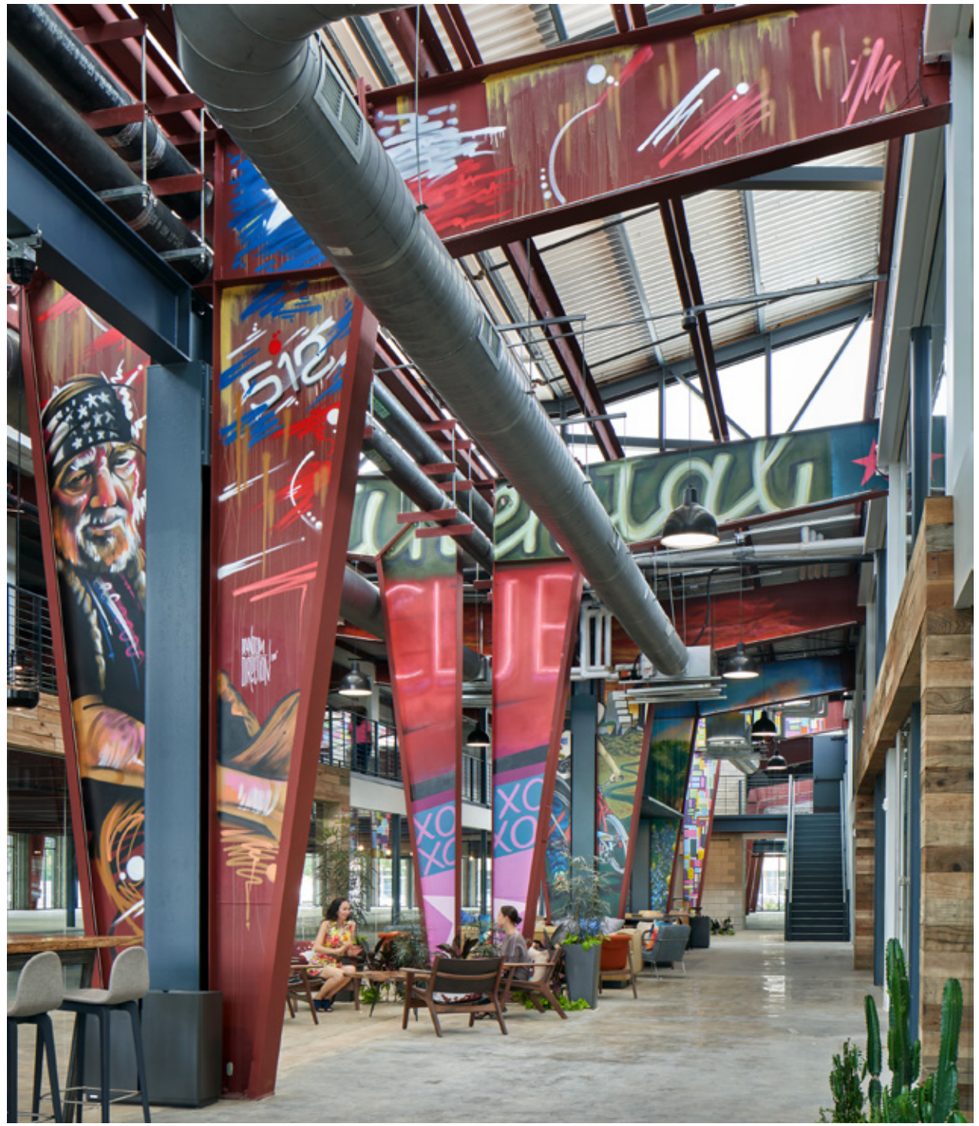
While the number of projects currently in the commercial deconstruction and salvage pipeline and the quantities of salvaged materials are limited, these projects demonstrate the presence of deconstruction skills in the marketplace and the potential skills and demand to scale up the commercial construction material reuse market.

SALVAGED MATERIALS FROM COMMERCIAL BUILDING SITES

Building	Quantity/SF [1]	Carpet Tiles (SF)	Doors	Cabinetry [2] (LF)	Light Fixtures	Sinks	Restroom Partitions
1	350,000	-	-	1266 [3]	-	18	-
2	400,000	160,000	920	12	-	-	-
3	350,000	-	379	124 [4]	-	-	-
4	95,000	52,100	112	-	-	-	-
5	400,000	-	55	200	74	10	30
6	225,000	4,200	44	24	200	-	90
7	50,100	8,635	-	50 [5]	-	5	-
8	49,800	26,945	-	12 [5]	-	5	-
9	44,700	11,846	-	34 [5]	-	3	-
10	50,456	16,000	-	60 [5]	-	2	-

NOTES

[1] Only includes square footage that was deconstructed or renovated, not the entire building.
[2] The Cabinetry category includes kitchen cabinets, bathroom vanities, laboratory cabinets, and installed workstations with cabinets and lockers
[3] Total cabinets = 1266: 1160 labs, 53 kitchens, 9 restrooms, 44 lockers.
[4] Total cabinets = 124: 92 labs & kitchen combined; 32 lockers
[5] All the recovered cabinetry were kitchen cabinets.

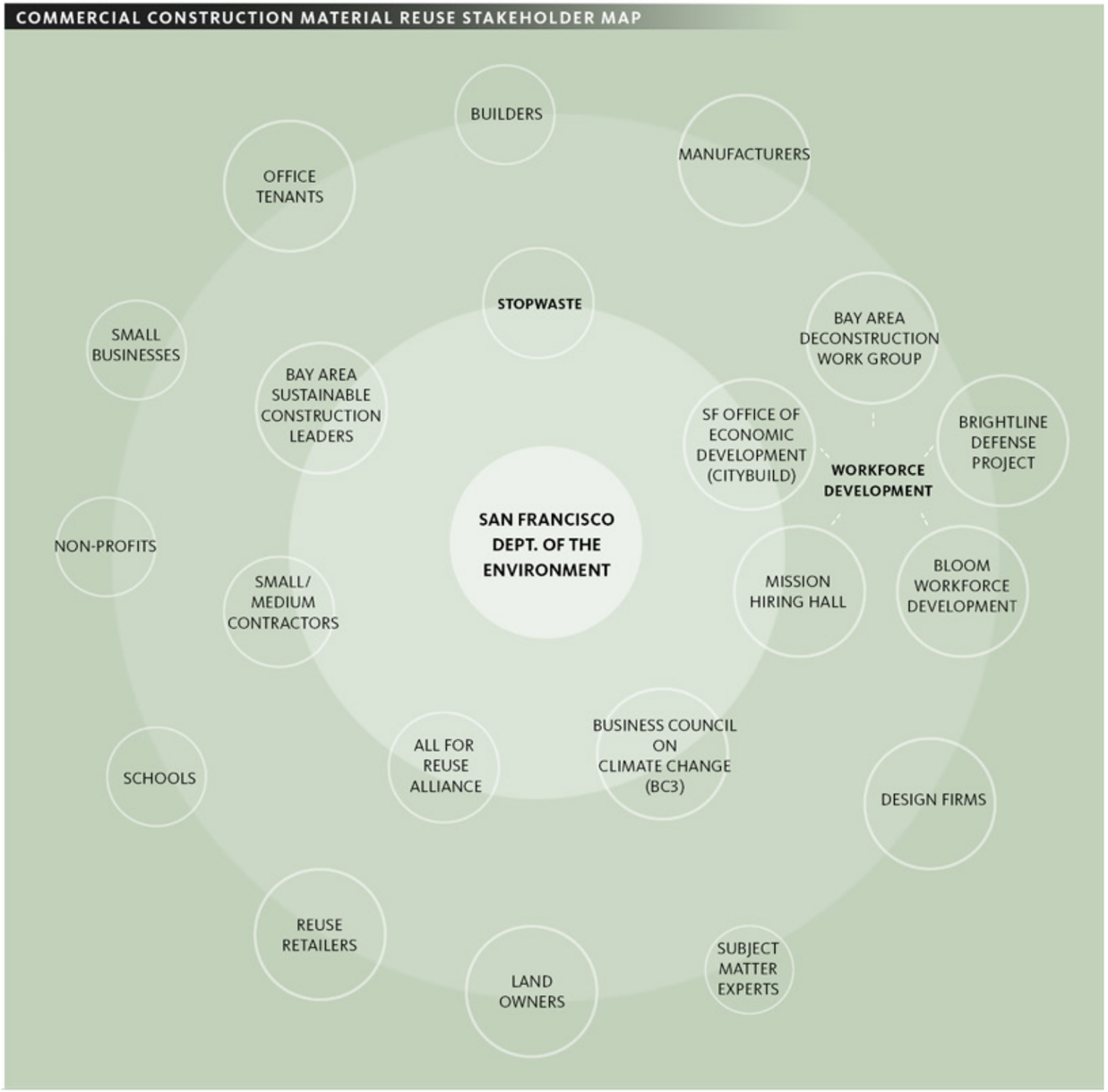


***above*: UpCycle, Austin, Texas, by Gensler.**
The design of a multi-tenant creative office space through reused materials including structure, building skin, decorative design features. The trusses are covered in graffiti by local artists.

1.3 Stakeholder Landscape

For the circular economy to evolve and gain traction within the Architecture, Engineering and Construction industry, partnerships are essential. In order to transform the design process into an increasingly reuse friendly, circular network, industry stakeholders will need to develop policies and evolve processes to simplify and encourage reuse on projects.

To develop the concepts in this study, our team identified numerous stakeholder partnerships that are either already working in the deconstruction and reuse market, have expressed interest in becoming a key player, and are critical to the eventual success of scaling up the commercial material reuse market. These partners were engaged through the visioning workshop, interviews, and feedback reviews to build enthusiasm and increase the potential for success of this evolving model.



1.4 Project Vision and Success Criteria

The team hosted a two hour project visioning session to develop a project vision and success criteria in collaboration with industry stakeholders, including members of the design, construction, and reuse industry.

The outcomes focused on how a piece of physical infrastructure could impact the commercial construction re-use market and what it would take to guarantee the success of this intervention.

1
VISION

A flexible, relocatable, and replicable system that promotes, facilitates, and enhances the commercial construction material reuse market by:

- Providing a facility for the intake and redistribution of salvaged/surplus building products.
- Hosting programs to connect the dots for last mile extended producer responsibility.
- Offering an 'escrow' model to align product availability with construction schedules, and
- Delivering community programs to cultivate workforce development, small business enterprise, and entrepreneurial innovation.

2
SUCCESS CRITERIA

OPERATIONALLY STREAMLINED
- Simple to engage inventory tools to facilitate design and construction planning
- Organized broker system to facilitate flow of materials
- Based on transportation / storage module (i.e., pallet -> truck)

ECONOMICALLY VIABLE
- Financially self sustaining
- Procedural and financial incentives for builders (warranties, LEED paperwork, etc.)

EXPERIENTIALLY ENGAGING
- A place for people, not just materials
- Well designed user/materials interface (i.e., showrooms)
- Non-trade programs (i.e., artist in residence)
- Integrated online interface

COMMUNITY-FOCUSED
- Workforce development and training programs
- Community engagement opportunities
- Deconstruction education

02

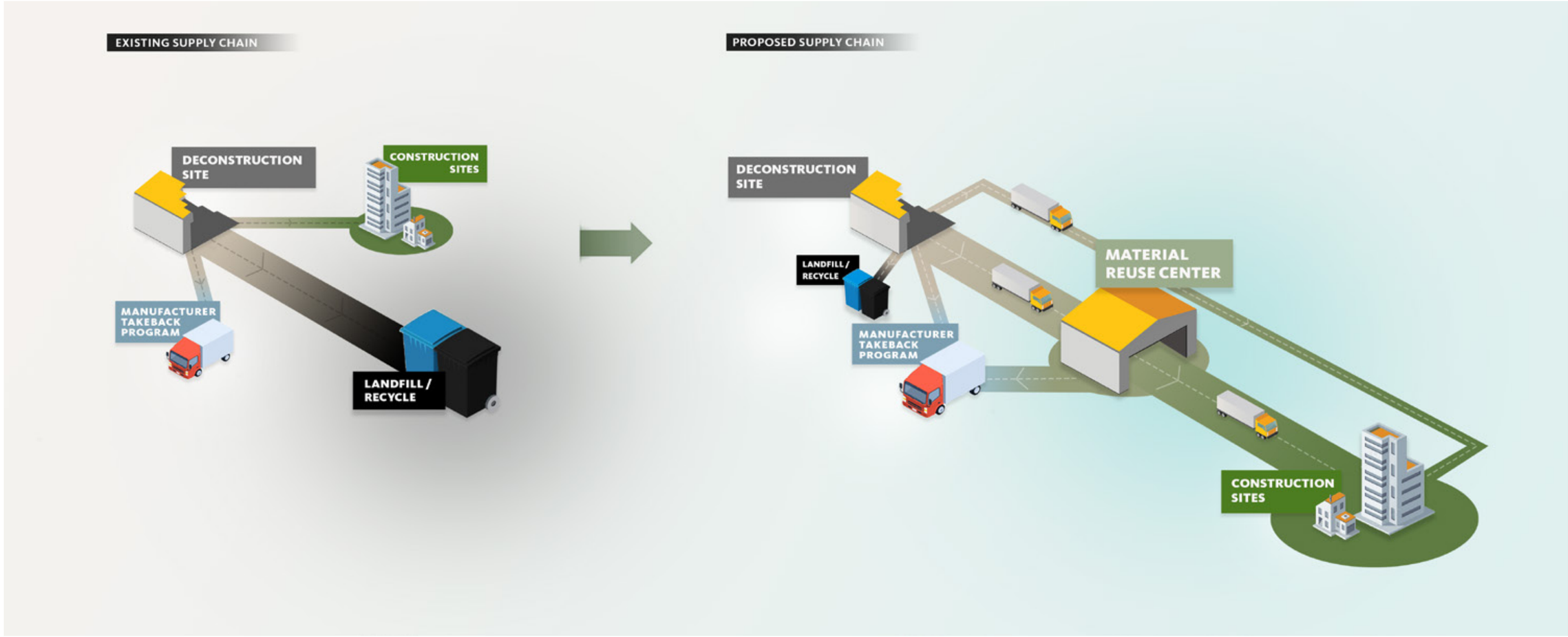
Building Material Reuse Supply Chain Analysis

2.1 Supply Chain Analysis

To begin the analysis of commercial construction material reuse supply chain intervention, it's helpful to visualize a simplified diagram of the current supply chain and compare that to a new potential supply chain.

The current system includes commercial interior space undergoing deconstruction or demolition, with materials being sent, on a per project basis, to landfill, to manufacturers for take-back programs, or directly to new tenant improvement construction projects, as described in the Project Context section of Chapter 1.

The proposed supply chain inserts a material reuse center between deconstruction and new construction to increase the amount of materials that are salvaged from deconstruction sites and provide a more prominent and accessible market place for diversion to new commercial interior build-outs and also allow for better aggregation.



2.2 Reuse Market Potential

To begin an assessment of the commercial construction reuse market size, we begin with developing an estimate for the size of the annual commercial interior construction market in San Francisco and then deduct the amount of materials likely available for eventual reuse based on historical project data.

Compiling the demolition permit data available from the San Francisco Department of Building Inspection (SF DBI), we calculate total square footage of commercial interior demolition, using base year 2019 as a pre-pandemic typical.

Using a 4% typical growth rate, established based on the average growth from analysis of historical data between 2013-2019, we project the total square footage of deconstruction estimated within San Francisco for the 10 year period from 2022 to 2031.

Based upon quantity per square foot averages calculated from 18 sample projects (see Appendix 5.2: Sample Project Analysis), we estimate the total quantity of materials being removed in the San Francisco commercial interiors construction market across 9 material categories that have been identified as promising targets for reuse based on the following criteria:

- Building materials that are commonly found in commercial tenant improvements.
- Building materials that have high potential for reuse
- Building materials that can be identified from drawings and floor plans.

Based on these criteria, the selected building materials for study and potential reuse are:

- Doors
- Ceiling Tiles
- Carpet Tiles
- Cabinetry
- Kitchen Sinks
- Bathroom Partitions
- Bathroom Doors
- Bathroom Sinks
- Light Pendants

The resulting total quantities of each material projected to be removed from commercial interiors projects over the next decade are presented in the following table.

A POTENTIAL REUSE FACILITY WILL BE ABLE TO AGGREGATE MATERIALS FROM SMALL PROJECTS TO MEET MINIMUM TAKE-BACK QUANTITY REQUIREMENTS WHERE THAT ISN'T CURRENTLY POSSIBLE.

SAN FRANCISCO DECONSTRUCTION MARKET SIZE ESTIMATE AND PROJECTION

		PROJECTIONS (4% ANNUAL GROWTH)									
	BASE YEAR 2019	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Aggregate
Total Deconstruction SF	1,946,000	2,024,000	2,105,000	2,189,000	2,277,000	2,368,000	2,463,000	2,562,000	2,664,000	2,771,000	2,882,000	**24,305,000**
Material	**Quantity/SF**											
Carpet Tiles (SF)	0.8081	1,636,000	1,701,000	1,769,000	1,840,000	1,914,000	1,990,000	2,070,000	2,153,000	2,239,000	2,329,000	**19,642,000**
Ceiling Tiles (SF)	0.7744	1,567,000	1,630,000	1,695,000	1,763,000	1,834,000	1,907,000	1,984,000	2,063,000	2,146,000	2,232,000	**18,821,000**
Doors (#)	0.0022	4,500	4,700	4,900	5,100	5,300	5,500	5,700	5,900	6,200	6,400	**54,100**
Cabinetry (LF)	0.0011	2,200	2,300	2,400	2,500	2,600	2,700	2,800	3,000	3,100	3,200	**27,000**
Bathrooms Doors (#)	0.0003	670	690	720	750	780	810	840	880	910	950	**8,000**
Bathroom Partitions (#)	0.0003	560	580	600	630	650	680	710	730	760	790	**6,690**
Bathrooms Sinks (#)	0.0003	550	570	590	620	640	670	690	720	750	780	**6,580**
Kitchen Sinks (#)	0.0001	220	230	230	240	250	260	270	290	300	310	**2,610**
Pendant Lights (#)	0.0006	1,300	1,300	1,400	1,400	1,500	1,600	1,600	1,700	1,800	1,800	**15,400**

2.2 Reuse Market Potential

Due to a number of factors, including damage during deconstruction or during transportation, not all materials being deconstructed will be available for reuse.

Based on Madrone's deconstruction expertise, we developed Best-Case, Conservative, and Worst-Case estimates for the recoverability of each material analyzed.

RECOVERABILITY SCENARIOS BY MATERIAL

	Scenarios*		
Material	**Best-Case**	**Conservative**	**Worst-Case**
Carpet Tiles	80%	60%	40%
Ceiling Tiles	70%	60%	40%
Doors	85%	75%	50%
Cabinetry	85%	75%	50%
Bathrooms Doors	85%	75%	50%
Bathroom Partitions	85%	75%	50%
Bathrooms Sinks	85%	75%	50%
Kitchen Sinks	85%	75%	50%
Pendant Lights	85%	75%	50%

*The recoverability percentages of the materials listed are rough estimates based on Madrone's deconstruction and demolition experience, and have not been verified through actual historical deconstruction data.

Specific factors influencing recoverability estimates for materials include:

- The percentage calculation considers the material's existing condition, installation method, deconstruction and disassembling skills, and material assembling for transportation and storage.
- Carpet tiles have increased wear on higher transit areas such as hallways which diminishes the material quality.
- The success of the recoverability of carpet tiles will depend on the amount of adhesive used at the time of installation, with a higher amount of adhesive on the backing reducing reusability.
- Ceiling tiles also have a lower percentage of recoverability due to the high probability of breakage during the removal and stacking phases.

All three scenarios consider different levels of the probability of the materials not being in optimal condition for reuse and the likelihood of damage when removing or assembling the material for transportation. The Best-Case scenario percentages are based on the assumption that all personnel removing the materials have deconstruction training and the materials are in good condition for reuse. The Conservative and the Worst-Case scenario percentages are based on the assumption that not all materials are in good condition for reuse.

Using the Conservative estimates, we are able to develop an estimate of the total quantity of potential commercial construction material reuse supply for San Francisco.

SAN FRANCISCO POTENTIAL REUSE MATERIAL SUPPLY

		PROJECTIONS										
Material	**Recoverability**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**Aggregate**
Carpet Tiles (SF.)	60%	981,600	1,020,600	1,061,400	1,104,000	1,148,400	1,194,000	1,242,000	1,291,800	1,343,400	1,397,400	**11,784,600**
Ceiling Tiles (SF.)	60%	940,200	978,000	1,017,000	1,057,800	1,100,400	1,144,200	1,190,400	1,237,800	1,287,600	1,339,200	**11,292,600**
Doors (#)	75%	3,375	3,525	3,675	3,825	3,975	4,125	4,275	4,425	4,650	4,800	**40,650**
Cabinetry (LF)	75%	1,650	1,725	1,800	1,875	1,950	2,025	2,100	2,250	2,325	2,400	**20,100**
Bathrooms Doors (#)	75%	503	518	540	563	585	608	630	660	683	713	**6,000**
Bathroom Partitions (#)	75%	420	435	450	473	488	510	533	548	570	593	**5,018**
Bathrooms Sinks (#)	75%	413	428	443	465	480	503	518	540	563	585	**4,935**
Kitchen Sinks (#)	75%	165	173	173	180	188	195	203	218	225	233	**1,950**
Pendant Lights (#)	75%	975	975	1,050	1,050	1,125	1,200	1,200	1,275	1,350	1,350	**11,550**

2.3 Impact Analysis

We then calculate the economic value and embodied energy that would be saved if all potential available materials were reused over the next decade, highlighting the total potential impact of the reuse market.

The embodied energy saved is conceptualized as the amount of energy used to heat house in the Bay Area for a year.

TOTAL POTENTIAL EMBODIED ENERGY SAVED REPRESENTS MORE ENERGY THAN WHAT'S REQUIRED TO HEAT EVERY HOME IN SAN FRANCISCO FOR A YEAR.[6]

NOTES

[1] Economic value of ceiling tiles is based on pallet storage service of the manufacturer's take-back program.
[2] Sale prices are not available, so avoided disposal recycled costs were used.
[3] Embodied energy is calculated here as the energy consumed during the manufacturing of products, including extraction, transportation, and assembly, as a representation the energy saved through reuse.
[4] Mega Joules per unit are calculated as weight x MJ.kg divided by 4 to express MJ/SF. All other material types are expressed in MJ/each unit.
[5] Assumes 60,000 average BTUs required to heat the average Bay Area house.
[6] 362,141 total households in San Francisco at the time of the 2020 census.

ECONOMIC VALUE OF MATERIALS

Material	Economic Value	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Aggregate
Carpet Tiles (SF)	$0.50	$490,800	$501,300	$530,700	$552,000	$574,200	$597,000	$621,000	$645,900	$671,700	$698,700	**$5,892,300**
Ceiling Tiles (SF) [1]	$0.03	$28,206	$29,340	$30,510	$31,734	$33,012	$34,326	$35,712	$37,134	$38,628	$40,176	**$338,778**
Doors (#)	$25.00	$84,375	$88,125	$91,875	$95,625	$99,375	$103,125	$106,875	$110,625	$116,250	$120,000	**$1,016,250**
Cabinetry (LF)	$50.00	$82,500	$86,250	$90,000	$93,750	$97,500	$101,250	$105,000	$112,500	$116,250	$120,000	**$1,005,000**
Bathrooms Doors (#) [2]	$1.50	$754	$776	$810	$844	$878	$911	$945	$990	$1,024	$1,069	**$9,000**
Bathroom Partitions (#) [2]	$1.50	$630	$653	$675	$709	$731	$765	$799	$821	$855	$889	**$7,526**
Bathrooms Sinks (#)	$20.00	$8,250	$8,550	$8,850	$9,300	$9,600	$10,050	$10,350	$10,800	$11,250	$11,700	**$98,700**
Kitchen Sinks (#)	$50.00	$8,250	$8,625	$8,625	$9,000	$9,375	$9,750	$10,125	$10,875	$11,250	$11,625	**$97,500**
Pendant Lights (#)	$25.00	$24,375	$24,375	$26,250	$26,250	$28,125	$30,000	$30,000	$31,875	$33,750	$33,750	**$288,750**
	TOTAL DOLLARS	**$728,140**	**$756,994**	**$788,295**	**$819,212**	**$852,796**	**$887,177**	**$920,806**	**$961,520**	**$1,000,957**	**$1,037,909**	**$8,753,804**

EMBODIED ENERGY OF MATERIALS[3]

Material	Total Embodied Energy (MJ/Unit)	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Aggregate
Carpet Tiles (SF) [4]	21	20,613,600	21,432,600	22,289,400	23,184,000	24,116,400	25,074,000	26,082,000	27,127,800	28,211,400	29,345,400	**247,476,600**
Ceiling Tiles (SF)	Not Available											-
Doors (#)	1,308	4,414,500	4,610,700	4,806,900	5,003,100	5,199,300	5,395,500	5,591,700	5,787,900	6,082,200	6,278,400	**53,170,200**
Cabinetry (LF)	934	1,541,100	1,611,150	1,681,200	1,751,250	1,821,300	1,891,350	1,961,400	2,101,500	2,171,550	2,241,600	**18,773,400**
Bathroom Doors (#)	60	30,150	31,050	32,400	33,750	35,100	36,450	37,800	39,600	40,950	42,750	**360,000**
Bathroom Partitions (#)	90	37,800	39,150	40,500	42,525	43,875	45,900	47,925	49,275	51,300	53,325	**451,575**
Bathroom Sinks (#)	20	8,250	8,550	8,850	9,300	9,600	10,050	10,350	10,800	11,250	11,700	**98,700**
Kitchen Sinks (#)	28	4,620	4,830	4,830	5,040	5,250	5,460	5,670	6,090	6,300	6,510	**54,600**
Pendant Lights (#)	10	9,750	9,750	10,500	10,500	11,250	12,000	12,000	12,750	13,500	13,500	**115,500**
	TOTAL MEGA JOULES	**26,659,770**	**27,747,780**	**28,874,580**	**30,039,465**	**31,242,075**	**32,470,710**	**33,748,845**	**35,135,715**	**36,588,450**	**37,993,185**	**320,500,575**
	Bay Area House Heating Equivalent [5]	**421,136**	**438,322**	**456,122**	**474,523**	**493,521**	**512,929**	**533,119**	**555,027**	**577,976**	**600,166**	**5,062,841**

2.3 Impact Analysis

Using a detailed labor analysis of deconstruction activities (see Appendix Section 5.3), we calculate the estimated workforce impact of the deconstruction labor involved in the salvage of the identified materials, in total hours and in today's wage dollars.

Deconstruction requires higher skilled labor and more person hours than demolition per square foot, resulting in additional skilled workforce development opportunities.

WORKFORCE IMPACT OF REUSE ACTIVITY

Material	Labor Required (Hours/Unit)	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Aggregate
Carpet Tiles (SF)	0.008	7,853	8,165	8,491	8,832	9,187	9,552	9,936	10,334	10,747	11,179	**94,277**
Ceiling Tiles (SF)	0.008	7,522	7,824	8,136	8,462	8,803	9,154	9,523	9,902	10,301	10,714	**90,341**
Doors (#)	0.200	675	705	735	765	795	825	855	885	930	960	**8,130**
Cabinetry (LF)	0.600	990	1,035	1,080	1,125	1,170	1,215	1,260	1,350	1,395	1,440	**12,060**
Bathrooms Doors (#)	1.333	670	690	720	750	780	810	840	880	910	950	**8,000**
Bathroom Partitions (#)	2.667	1,120	1,160	1,200	1,260	1,300	1,360	1,420	1,460	1,520	1,580	**13,380**
Bathrooms Sinks (#)	0.267	110	114	118	124	128	134	138	144	150	156	**1,316**
Kitchen Sinks (#)	0.267	44	46	46	48	50	52	54	58	60	62	**520**
Pendant Lights (#)	0.800	780	780	840	840	900	960	960	1,020	1,080	1,080	**9,240**
	TOTAL HOURS	**19,763**	**20,519**	**21,3366**	**22,206**	**23,113**	**24,062**	**24,986**	**26,034**	**27,093**	**28,121**	**237,264**
	Workforce Impact (Deconstruction Only)	$1,838,338	$1,880,892	$1,928,629	$1,975,961	$2,027,055	$2,080,470	$2,132,556	$2,191,571	$2,251,239	$2,309,138	**$13,605,849**

NOTES

The following non material specific labor is included at the deconstruction site:

- Surveyor @ $60,000/year
- Manager @ $75,000/year
- Forklift Operator @ $45,000/year
- Data Collector @ $60,000/year

Deconstruction work is completed by union labor @ $33.80/hour.

2,080 hours of work per person per year with a 60% work efficiency rate
(60% of hours are spent on deconstruction tasks.)

2.4 Regional Potential

To estimate how the detailed analysis of the San Francisco deconstruction market potential may be extrapolated to the Bay Area, we gather vacancy data from three of the largest commercial office space brokers in the Bay Area: Cushman and Wakefield, JLL, and CBRE.

Totalling this vacancy for each of the Bay Area metropolitan areas, we then calculated the percentage of this vacancy that we could assume would be turned over each year as commercial tenant improvement deconstruction work using the number that we had calculated for San Francisco (roughly 1.7%).

Multiplying this by the total numbers in each of the metropolitan areas gives us an estimate of a total of approximately 6 million square feet of annual office deconstruction across the Bay Area, roughly 3.1X the size of San Francisco as a stand alone market. This multiplier could then be applied to detailed analysis described for San Francisco to estimate the Bay Area market, although the data is admittedly less reliable.

NOTES

[1] Data from Cushman and Wakefield Office Market Report for Q42021.

[2] Data from JLL Office Market Report for Q42021

[3] Data from CBRE Market View Q22021

[4] The Sq. Ft. is based on the analysis of the total square footage from TI permits that included non-structural demolition in 2019. Permit data obtained from San Francisco Dept. of Building Inspections.

TOTAL BAY AREA REGIONAL MARKET ESTIMATE

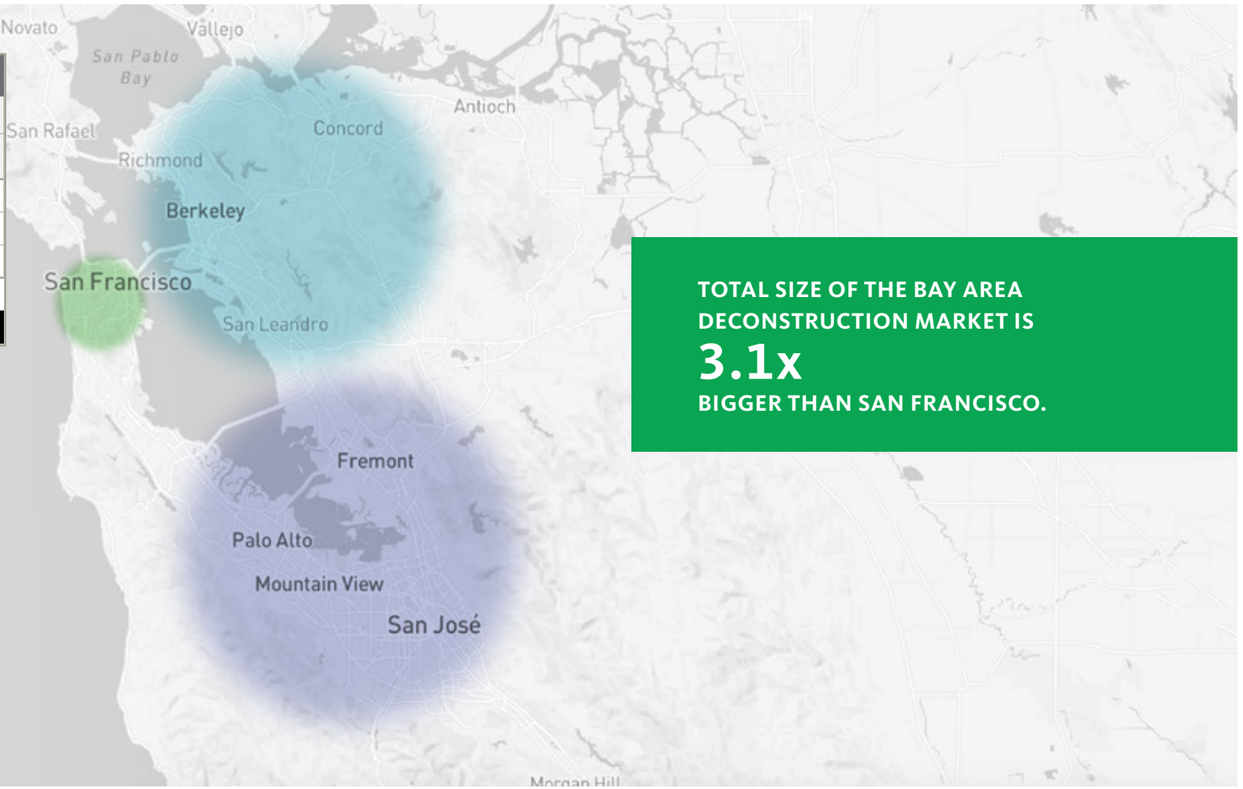
	TOTAL VACANCY			
	San Francisco [5]	East Bay [6]	South Bay [7]	Total
Cushman and Wakefield [1]	17,021,277	6,019,580	13,712,739	**36,753,596**
JLL [2]	12,020,540	10,907,888	9,701,233	**32,629,661**
CBRE [3]	84,820,063	66,697,910	132,155,193	**283,673,166**
TOTAL	**113,861,880**	**83,625,378**	**155,569,165**	**353,056,423**
Total Sq. Ft. of TI Permits	1,945,749 [4]	1,429,047	2,658,471	**6,033,268**

ASSUMPTIONS

[5] San Francisco analysis is based on the total square footage from TI permits that included non-structural demolition. Data obtained from DBI - San Francisco Dept. of Building Inspections

[6] East Bay data includes the following cities: Richmond, Berkeley, Oakland, Emeryville, Alameda, Concord, Walnut Creek, Danville, Dublin, La Morinda, Livermore, Pleasant Hill, Pleasanton, San Ramon, San Leandro

[7] South Bay data includes the following cities: Cupertino, Newark, Fremont, Milpitas, Menlo Park, Mountain View, San Jose, Palo Alto, Santa Clara, Sunnyvale, Campbell, Los Gatos, Saratoga



TOTAL SIZE OF THE BAY AREA DECONSTRUCTION MARKET IS

3.1x

BIGGER THAN SAN FRANCISCO.

03

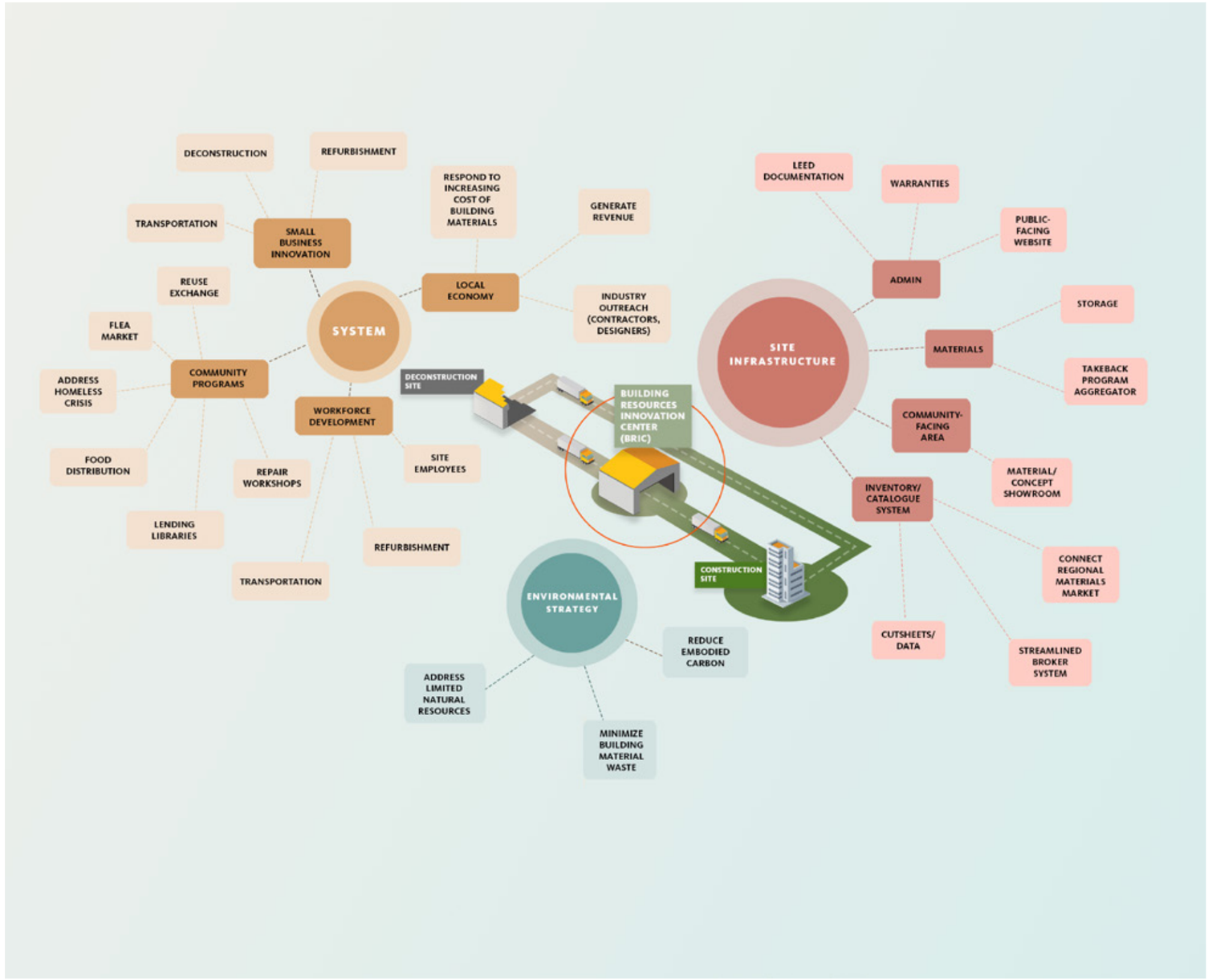
Building Material Reuse Center Concept

3.1 Concept Overview

Building upon the existing supply chain analysis, we propose a concept for a material reuse facility focused on streamlining deconstruction and redistribution through workforce development, inventory storage and management, and community engagement. SF Department of the Environment has branded this facility as the Building Reuse Innovation Center (BRIC), thinking beyond just materials storage and transfer. The intent of the facility is to increase reuse capabilities and broaden demand for recovered commercial construction materials while providing significant benefits for the surrounding community.

The proposed concept is based upon a model that assumes easy disassembly and relocation with a typical site occupancy taking place over a roughly 5 year period.

Materials would be aggregated at the facility to be channeled to both new construction projects and to manufacturer take-back programs.

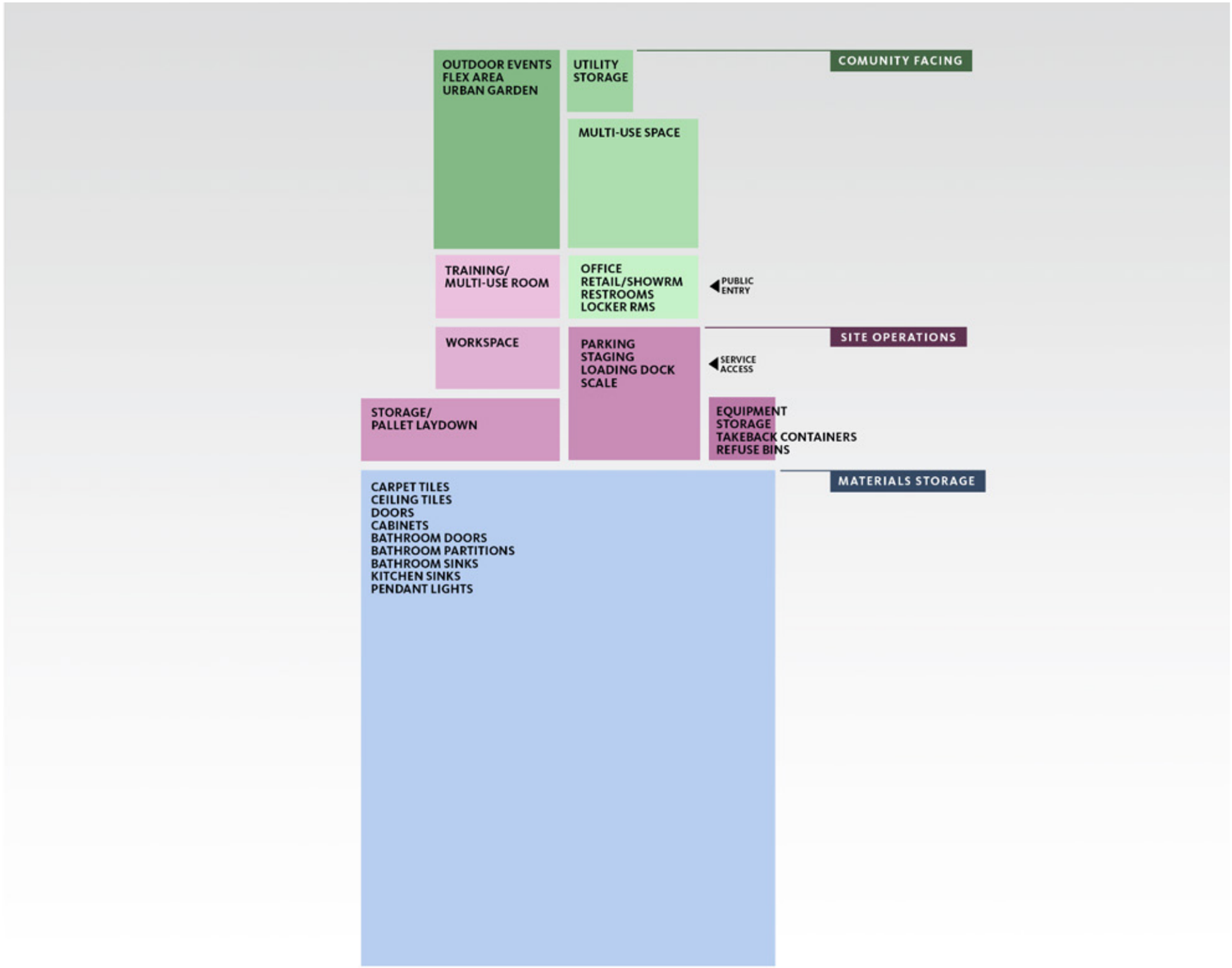


3.2 Program and Infrastructure Requirements

The program for the facility is organized into three areas. Each of these areas play a unique and equally important role in the function of the facility as detailed in this chapter.

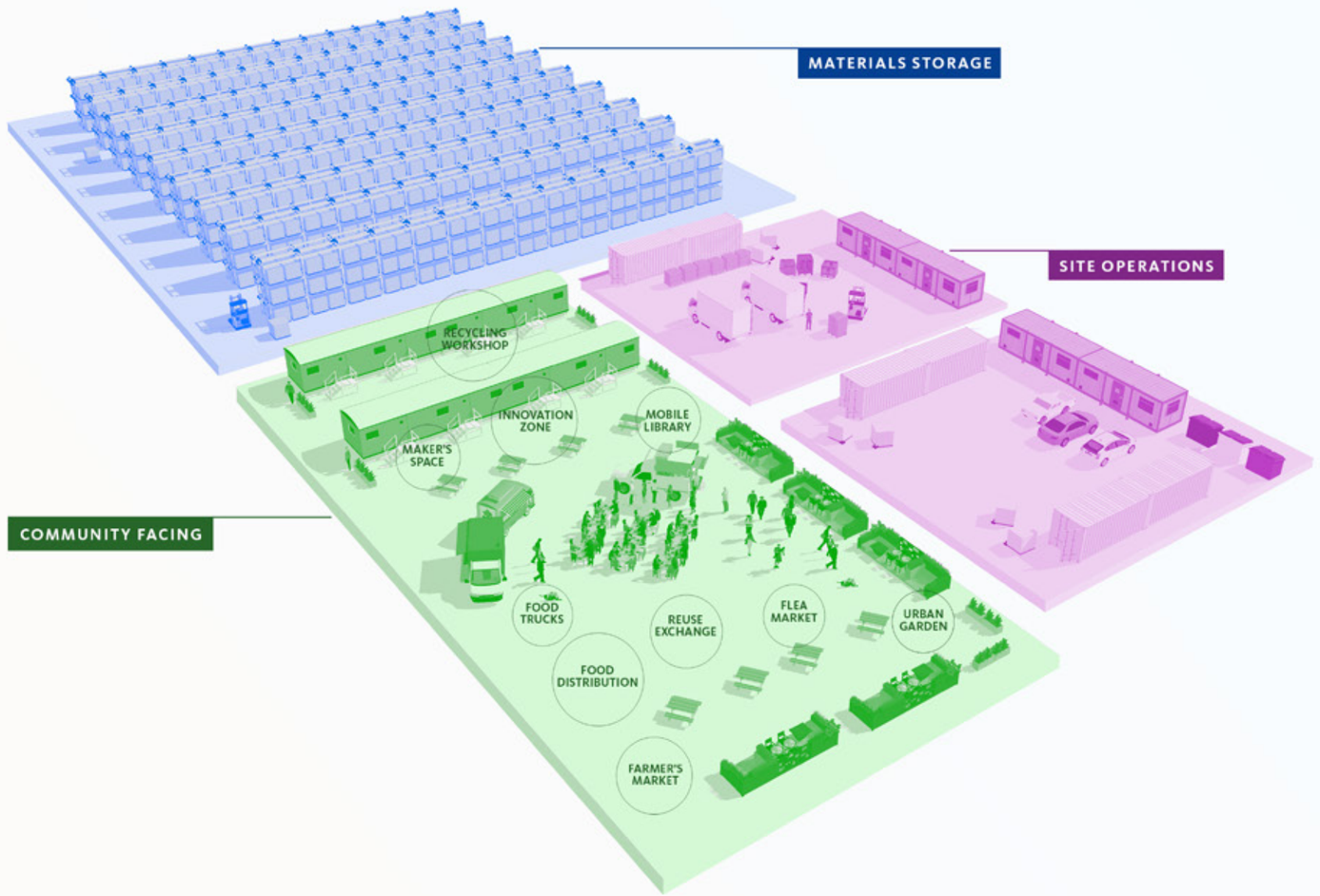
- Community Facing: The public facing portion of the facility and primary point of entry. This area provides space for public workshops and community programs in addition to a retail showroom and point of sale.
- Site Operations: The main point of entry and exit for building materials. This space is focused on materials packaging and staging, with a training room for workforce development activities.
- Materials Storage: Organized around the module of the pallet and forklift circulation, this flexible space for materials storage will be weather protected and allow for easy moving of materials.

Refurbishment capabilities are not included in the project program due to relatively high cost (intensive equipment and programmatic needs, in addition to the level of worker training required) and low financial return that a refurbishment facility would provide.



3.2 Program and Infrastructure Requirements

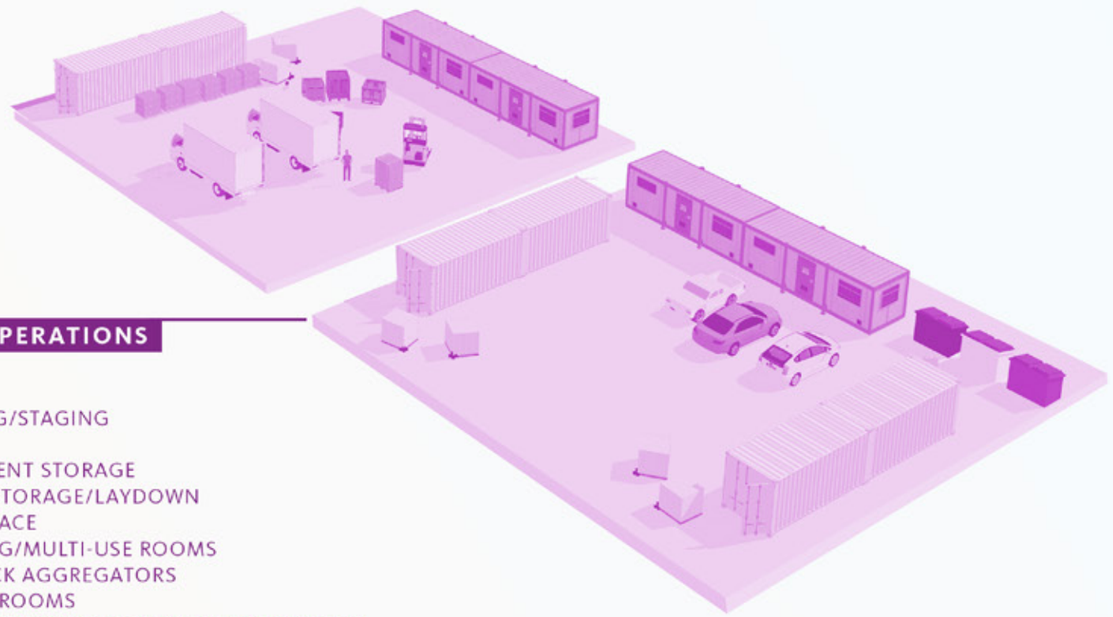
This visualization shows the character of what each part of this facility could feel like. The following pages delve into detail on each of the areas.



3.2 Program and Infrastructure Requirements

The site operations program is highly functional, focusing on site administration, materials movement, and site maintenance. The structures in this area are functional and efficient.

At this point, materials will be sorted for potential resale or manufacturer take-back aggregation.



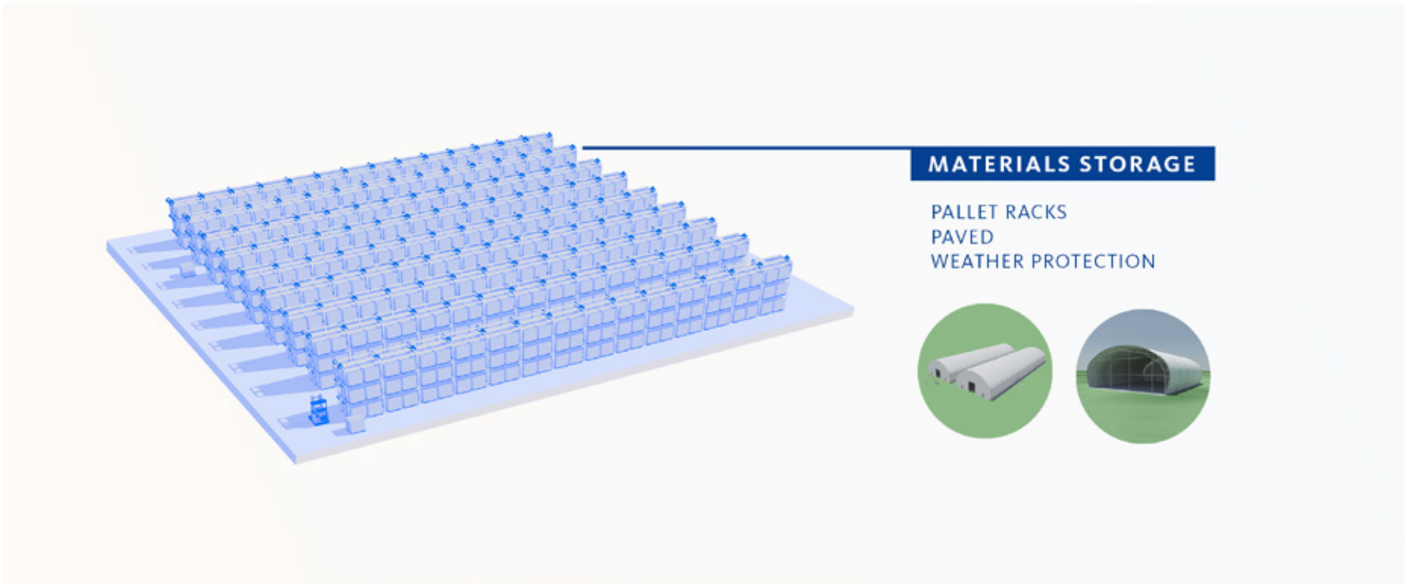
SITE OPERATIONS

OFFICE
LOADING/STAGING
SCALE
EQUIPMENT STORAGE
PALLET STORAGE/LAYDOWN
WORKSPACE
TRAINING/MULTI-USE ROOMS
TAKEBACK AGGREGATORS
LOCKER ROOMS
CENTRALIZED REFUSE COLLECTION STATION

3.2 Program and Infrastructure Requirements

The highly efficient materials storage area is organized around the unit of the pallet and forklift access. All materials should be palletized and stored in a weather protected enclosure. The enclosure would need to be provided with adequate lighting and fire life safety provisions to meet code requirements. Pallets can be stored on pallet racks if height allows.

Total quantities of materials able to be stored on each pallet is indicated in the table below. Based upon the impact analysis in Chapter 2, we are able to convert material quantity per pallet to a number of impact metrics, providing a guide to determine the optimal allocation of the limited material storage space for each material.



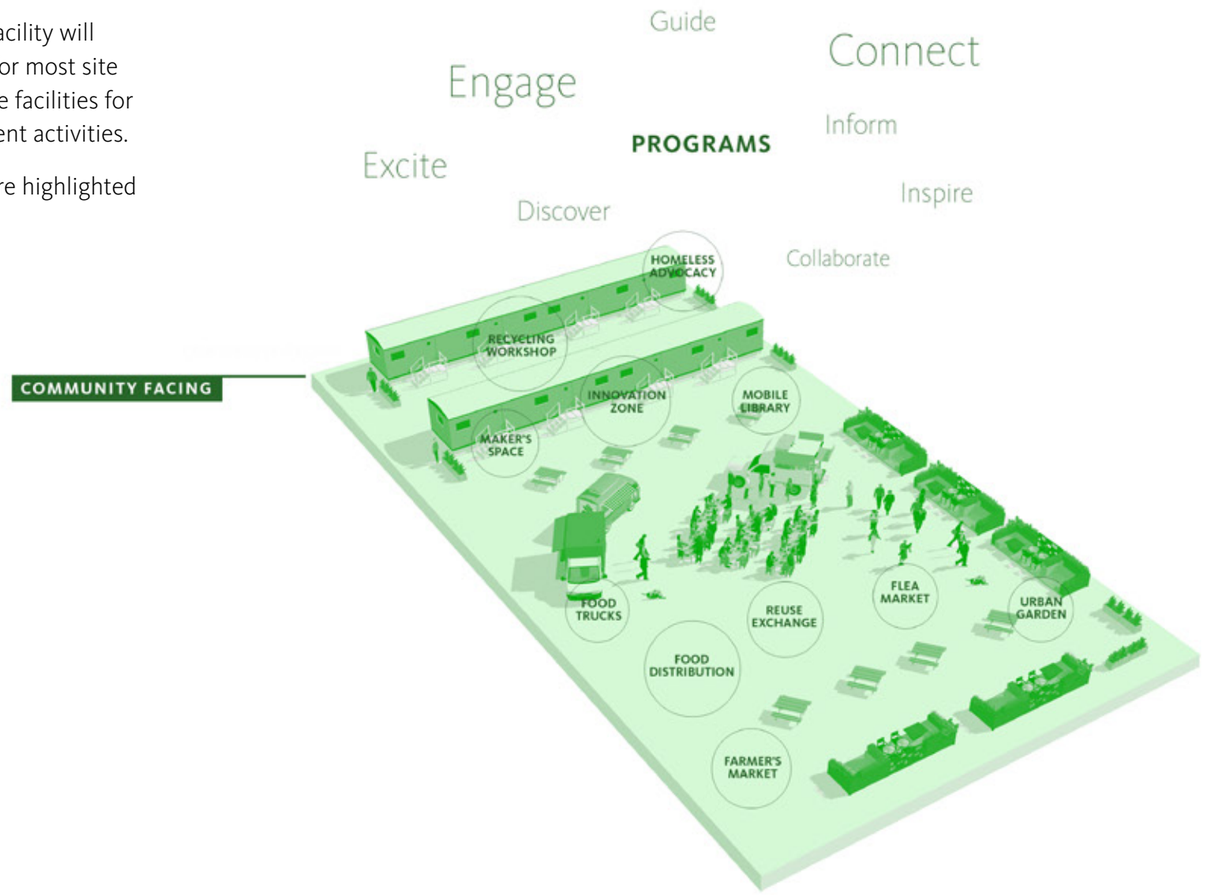
TRIPLE BOTTOM: NUMBERS BY PALLET

		3000 CARPET TILES (SF)	20 DOORS	15 KITCHEN CABINETS	10 BATHROOM SINKS	10 KITCHEN SINKS	10 LIGHT PENDANTS	20 BATHROOM DOORS	20 BATHROOM PARTITIONS	160 CEILING TILES (SF)
ECONOMIC	Retail Price	$1,500	$500	$1,125	$200	$500	$250	$30	$30	$30
SOCIAL (WORKFORCE)	Deconstruction Labor per Pallet	24 hours	3.2 hours	8.6 hours	2.4 hours	2.4 hours	4.5 hours	11 hours	11 hours	1.3 hours
ENVIRONMENTAL	Embodied Energy (Megajoules)	21 mj/unit rubber only, 24x24" 15,750 MJ	1308 mj/unit wood 26,160 MJ	934 mj/unit 14,010 MJ	182 mj/unit cast iron 1,820 MJ	721 mj/unit stainless steel 7,210 MJ	145 mj/unit 1,450 MJ	872 mj/unit aluminum 17,440 MJ	1308 mj/unit aluminum 26,160 MJ	Not Available
	What that means	Power a house for 40 years	Power a house for 66 years	Power a house for 35 years	Power a house for 5 years	Power a house for 18 years	Power a house for 4 years	Power a house for 44 years	Power a house for 66 years	

3.2 Program and Infrastructure Requirements

The public facing front door of the facility will be the primary point of experience for most site visitors. This area will provide flexible facilities for community programs and engagement activities.

Potential community partnerships are highlighted on the following page.



FACILITY

OUTDOOR EVENTS / FLEX AREA
- INVITING, LIVELY OPEN SPACE TO SERVE VARIOUS NEEDS OF THE COMMUNITY
- OPPORTUNITIES TO EXHIBIT LOCAL ARTISTS' WORK ON FENCING AND OTHER SURFACES
- URBAN GARDEN/ VEGETABLE PATCH
- OUTDOOR SEATING AREA

MULTI-USE ROOMS
- CONSTRUCTUION TRAILERS FOR FLEXIBILITY & MODULARITY
- CONVERTIBLE SPACE FOR VARIOUS COMMUNITY NEEDS
- FOLDING / MOBILE TABLES AND CHAIRS FOR INDOOR/OUTDOOR USE
- COUNTER-HEIGHT WORKSTATIONS

RETAIL / SHOWROOM
- SHOWCASE INNOVATIVE USE OF REUSE MATERIALS
- NON-COMMERCIAL MARKETPLACE FOR UNIQUE, REFURBISHED, OR LOW QUANTITY ITEMS TO INDIVIDUALS
- POINT OF SALE SYSTEM

UTILITY / STORAGE

RESTROOMS

3.2 Program and Infrastructure Requirements















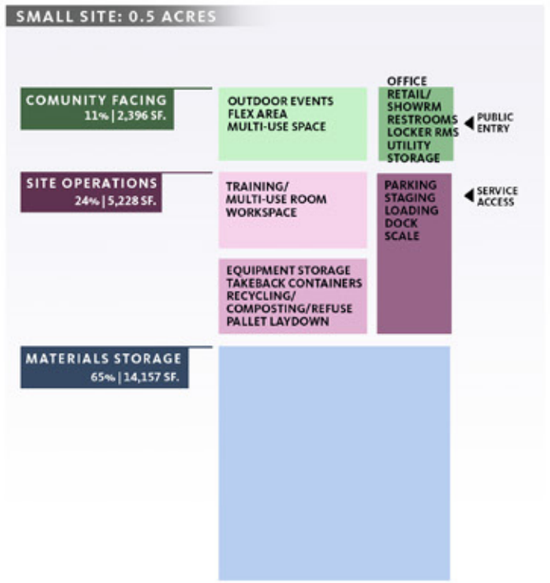


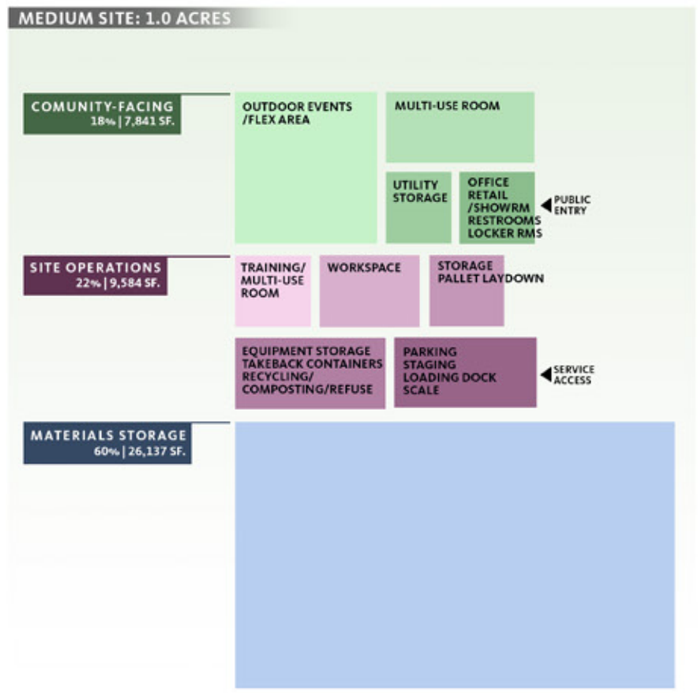

3.3 Site Configuration Options

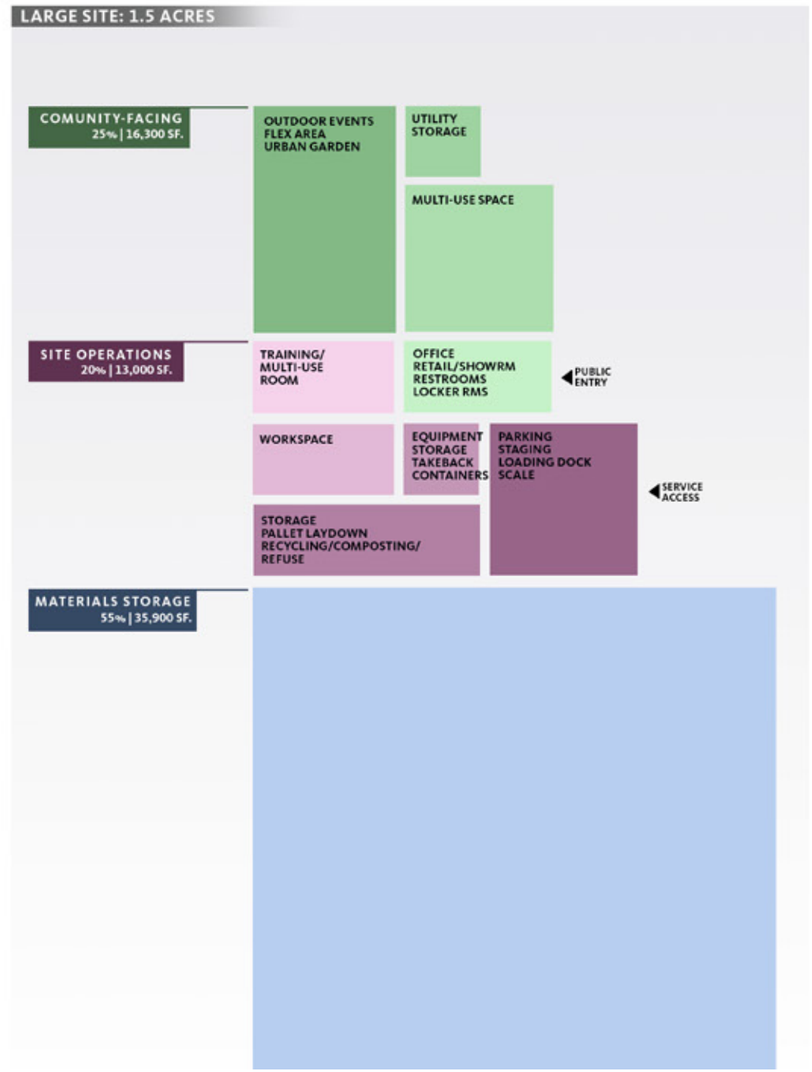
The diagrams show how the program can be modified to provide a flexible model that can accommodate inhabition of differently sized sites based on availability.

A 1.5 acre site provides an optimal balance of materials storage, site operations, and community programs.

As smaller sites are assessed, the site operations program needs to remain roughly constant for each site size, so the community facing programs and materials storage capabilities will be the areas that flex.







3.4 Budget

1
IMPLEMENTATION

Total Estimated Cost (2022 Dollars):
$2.6M - $5.1M

Costs Include:

- Fencing
- Lighting
- Materials Weather Protection
- Trailer Installation
- Asphalt Patching / Repair
- Utility Updgrades (Security, Wi-fi, Power)

2
OPERATIONS

Total Estimated Annual Cost (2022 Dollars):
$470K - $580K

Costs Include:

- Leased Equipment and Trailers
- Supplies
- Maintenance
- Community Outreach
- Insurance
- Operating Utilities
- Wages
- Licenses and Permits
- Insurance
- Asset Depreciation

NOTE: More detailed budget information can be found in Appendix Section 5.4

04
Site Assessment

4.1 Site Evaluation Criteria

We have developed the following criteria to assist with site selection for future development of material reuse center locations. These criteria balance physical, experiential, and financial needs to ensure that these centers are implemented with the greatest chance for success and impact.

1 LOCATION

- **Construction Activity:** Located near significant density of construction activity to reduce transportation time, energy, and costs.
- **Community Serving Programs:** Located near existing community serving programs and areas inhabitated by a population that could benefit from these programs will increase the potential success of these partnerships.

2 OWNERSHIP STRUCTURE

- **Mission Alignment:** Owned by governmental agencies that are aligned with mission of the reuse centers.
- **Financial:** Flexible lease terms, preferrable lease rates, and/or assistance with build out costs.
- **Approvals:** In-place use permits that allow this use and infrastructure that eliminates the need to pull building permits for implementation.

3 ACCESS

- **Public Transportation:** Near public transportation to allow easy community access.
- **Freeway Access:** Near Freeway access to allow for easy movement of materials.
- **Truck Access:** Adequate road width, turning radius dimensions, and paving sections to accomodate semi-truck access and turnaround.

4 SIZE / LAYOUT

- **Size:** 1.5 acres is ideal to accomodate a balance of program space. Smaller size reduces community program space. Larger size increases material throughout that needs to be supported as a result of additional site maintenance and operations costs.
- **Layout:** Multiple points of entry and a non-rectangular site allow for more access and programming options.

5 AMENITIES

- **Existing Buildings:** Existing site buildings that could provide housing for administrative and community program space will allow for greater operational functionality without additional approval costs.
- **Covered Area:** Materials storage area will need to be covered and protected. An existing large covered space would reduce site implementation costs.

6 INFRASTRUCTURE

- **Paving:** Existing site paving in good condition with the ability to withstand forklift traffic will reduce implemntation costs.
- **Utilities:** 110V power service and water supply is required. Sanitary sewer connection would be preferred to allow for plumbing fixture drain connections.
- **Security:** Existing site security fence and site security lighting will reduce implementation costs.

4.2 Sample Site Assessment

To test the site evaluation criteria and the proposed design concept, we look at one of two sites that SF Department of the Environment is currently discussing with Caltrans for potential location of the BRIC.

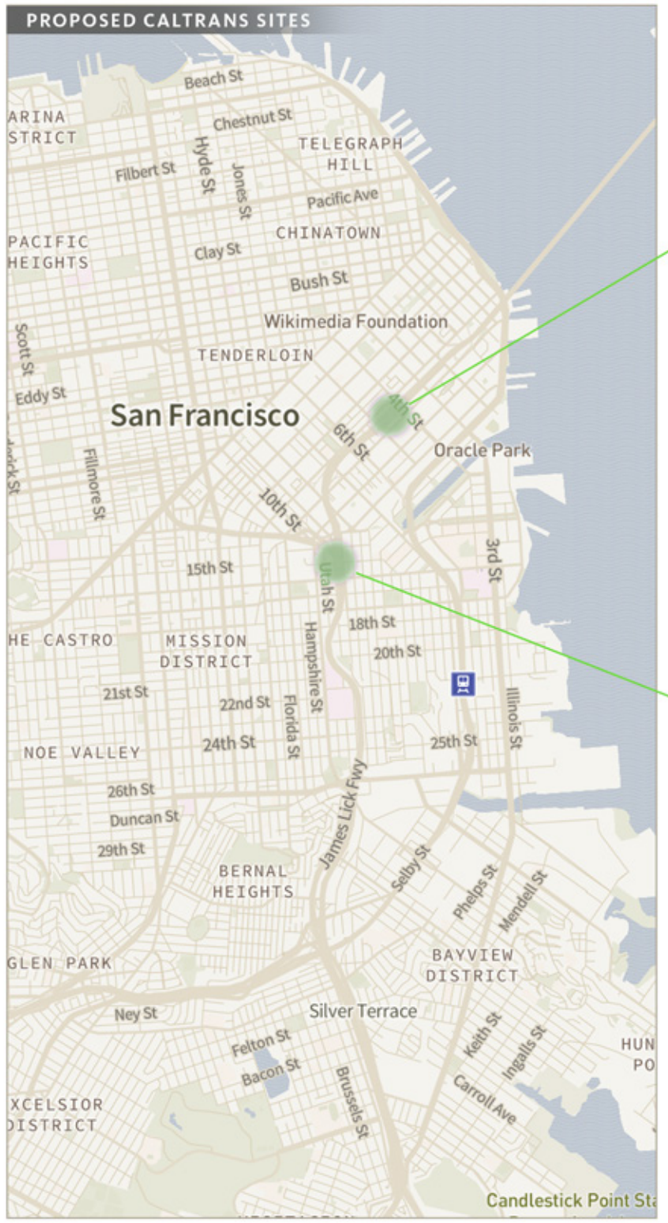
Both sites are slightly bigger than 1.5 acre ideal site size, located near significant commercial construction activity, and have easy freeway access. The following is an evaluation of the 4th & Harrison potential site in San Francisco:

1
LOCATION

- **Construction Activity:** Location within San Francisco provides access to significant activity.
- **Community Serving Programs:** Surrounding area hosts many community programs, allowing for significant partnership opportunities.

2
OWNERSHIP STRUCTURE

- **Mission Alignment:** Caltrans is very interested in alternative uses for the site and understands the project's goals.
- **Financial:** Caltrans is willing to structure favorable financial terms.
- **Approvals:** Use will be allowed without additional approvals and site includes infrastructure sufficient to minimize building permits. **Some building permits may still be required for covered materials areas and utility upgrades.**



4.2 Sample Site Assessment

3
ACCESS

- **Public Transportation:** Muni rail and bus stops are nearby allowing for easy access.
- **Freeway Access:** Immediately adjacent to freeway access.
- **Truck Access:** Adjacent streets provide adequate truck access dimensions.

4
SIZE / LAYOUT

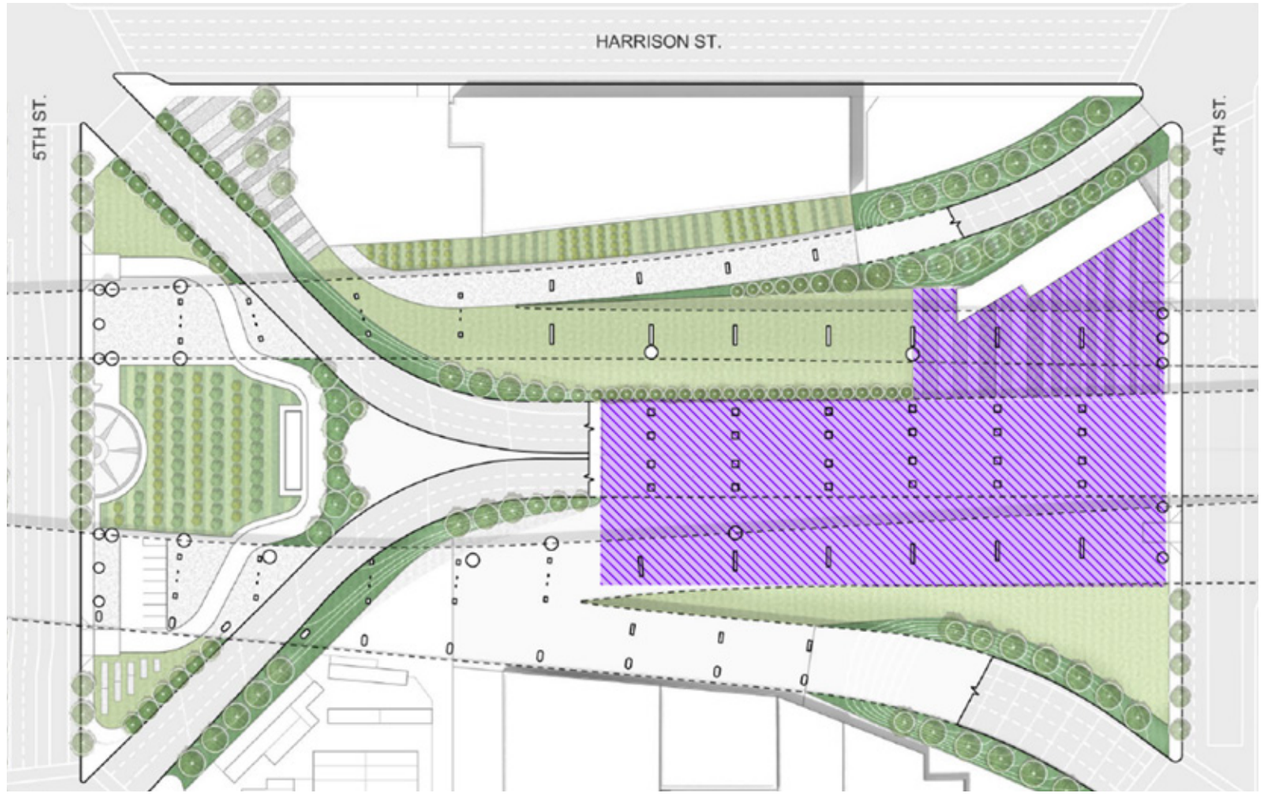
- **Size:** Site is an ideal size at 1.5 acres, allowing for a good mix of programs.
- **Layout:** Access is provided on two ends, with an L-shape that allows for multiple points of access and programming flexibility.

5
AMENITIES

- **Existing Buildings:** An existing building can be used to house community facing programs.
- **Covered Area:** Although some of the site area is covered by freeway infrastructure, a large enclosed area would likely need to be provided at materials storage.

6
INFRASTRUCTURE

- **Paving:** Existing paving is in good condition.
- **Utilities:** Existing 110V power service and water supply are provided. Sanitary sewer connection is provided to existing building. **Some additional utility upgrades would be required.**
- **Security:** Existing site security fence is provided and does not need to be upgraded.



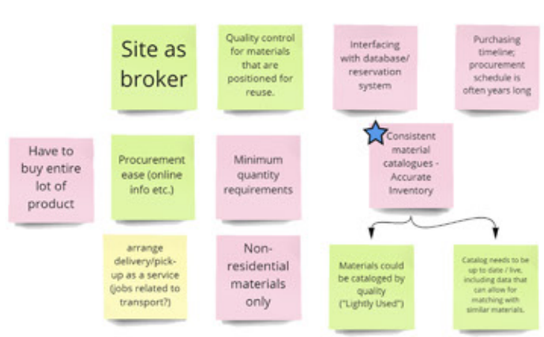
NOTES
Caltrans site on 4th Street + Harrison Street planned on SoMa Under Freeway Master Plan project by Public Works.

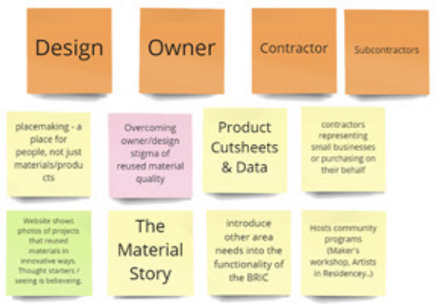
05
Appendix

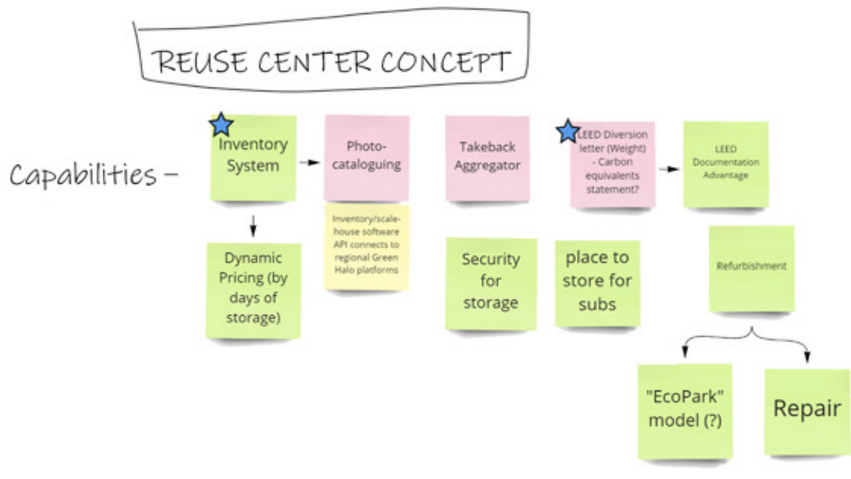
5.1 Visioning Session Notes

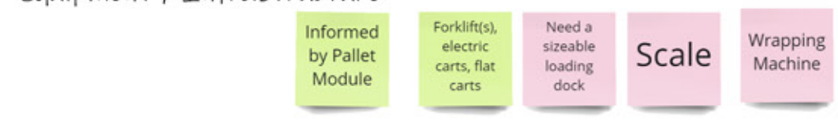
ATTENDEES

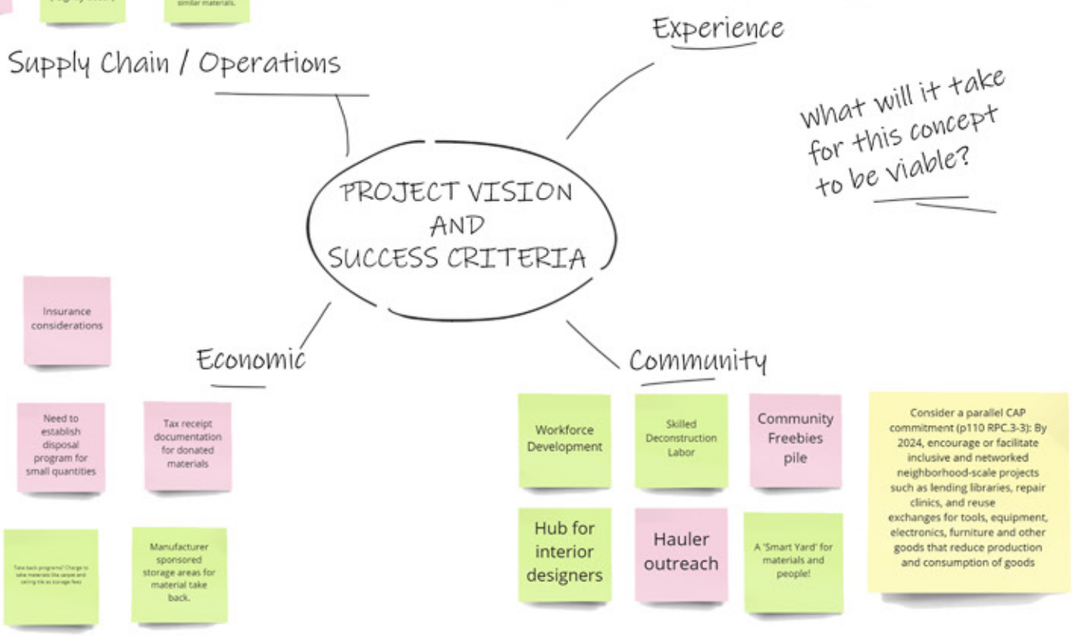
Miya Kitahara, StopWaste
Eden Brukman, SF. Dept. of Environments
James Slattery, SF. Dept. of Environments
Alejandra Arce Gomez, Madrone
Emi Lafountain, Turner Construction
Kena David, BCCI Construction
Kat Hanrahan, GCI Construction
Ted Reiff, The Reuse People
Michael Chambers, The Reuse People
Thomas Towey, Komorous-Towey
Gray Dougherty, Gensler
Kirsten Ritchie, Gensler
Marcus Hopper, Gensler
Jeehee Han, Gensler











5.2 Sample Project Analysis

Data from 18 sample projects was analyzed to develop an estimate of quantities of the materials being considered per square foot of deconstruction. The project information was gathered from actual project data from Gensler, Madrone,and The Reuse People.

Some projects indicate no material quantity for some categories of items as that information was not available. These data points have been left out of the averaging formulas.

The materials per square foot averages are applied to the total estimated annual square footage of commercial construction Chapter 2 to form the basis of projecting the potential size of the construction reuse market.

PROJECT #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Quantity / SF (Average)
PROJECT NAME	Salesforce Palo Alto	1150 Bayhill	1200 Bayhill	1250 Bayhill	Citygroup SF	Hall Capital SF - 6th Fl	Hall Capital SF - 7th Fl	Salesforce SF - 19th Fl	Salesforce SF - 20th Fl	Salesforce SF - 21th Fl	SOM SF	TPG - 30th Fl	Redwood City	Bayside Towers - 6th Fl	795 Folsom St. - 1st Fl	Zendesk SF	Gensler SF Office Renovation	Zoox Foster City	
PROJECT SF	22,500	50,100	49,800	44,700	51,134	7,936	17,361	19,864	19,864	19,864	25,455	17,426	50,456	23,989	27,000	51,810	52,000	22,540	
Carpet Tiles (SF)	17,404	35,715	37,410	35,080	45,673	6,309	15,102	13,159	15,976	16,548	23,727	13,686	36,695	23,244	17,531	51,810	46,800	15,854	
	0.773511	0.712874	0.751205	0.784787	0.893208	0.794985	0.869881	0.662455	0.804269	0.833065	0.932115	0.785378	0.727267	0.968944	0.649296	1.000000	0.900000	0.703372	**0.808145**
Ceiling Tiles (SF)	17,871	42,017	44,011	41,270	35,344	4,094	8,572	16,618	16,316	13,352	25,006	15,303	44,741	20,223	25,665	51,810	5,200	18,644	
	0.794267	0.838663	0.883755	0.923266	0.691204	0.515877	0.493750	0.836589	0.821385	0.672171	0.982361	0.878171	0.886733	0.843011	0.950556	1.000000	0.100000	0.827152	**0.774384**
Doors (#)	55	138	152	175	92	14	30	58	47	36	53	31	67	44	62	96	72	66	
	0.002444	0.002754	0.003052	0.003915	0.001799	0.001764	0.001728	0.002920	0.002366	0.001812	0.002082	0.001779	0.001328	0.001834	0.002296	0.001853	0.001385	0.002928	**0.002224**
Cabinetry (LF)	34	80	70	75	65	20	18	15	12	15	10	12	68	20	20	48	30	30	
	0.001511	0.001597	0.001406	0.001678	0.001271	0.002520	0.001037	0.000755	0.000604	0.000755	0.000393	0.000689	0.001348	0.000834	0.000741	0.000926	0.000577	0.001331	**0.001110**
Bathroom Doors (#)	8	12	12	12	6	6	7	7	7	7	7	6	7	4	8	21	-	12	
	0.000356	0.000240	0.000241	0.000268	0.000117	0.000756	0.000403	0.000352	0.000352	0.000352	0.000275	0.000344	0.000139	0.000167	0.000296	0.000405	-	0.000532	**0.000329**
Bathroom Partitions (#)	5	12	12	12	6	6	6	5	5	5	5	5	6	3	7	18	-	9	
	0.000222	0.000240	0.000241	0.000268	0.000117	0.000756	0.000346	0.000252	0.000252	0.000252	0.000196	0.000287	0.000119	0.000125	0.000259	0.000347	-	0.000399	**0.000275**
Bathroom Sinks W/ Faucet (#)	10	6	6	6	8	4	4	6	6	6	4	6	6	4	9	24	-	9	
	0.000444	0.000120	0.000120	0.000134	0.000156	0.000504	0.000230	0.000302	0.000302	0.000302	0.000157	0.000344	0.000119	0.000167	0.000333	0.000463	-	0.000399	**0.000271**
Kitchen Sinks with Faucet (#)	1	11	9	11	2	-	1	2	-	-	1	2	2	3	1	10	2	3	
	0.000044	0.000220	0.000181	0.000246	0.000039	-	0.000058	0.000101	-	-	0.000039	0.000115	0.000040	0.000125	0.000037	0.000193	0.000038	0.000133	**0.000107**
Pendant Lights (#)	-	-	20	-	-	-	-	16	24	-	-	-	-	-	13	12	-	15	
	-	-	0.000402	-	-	-	-	0.000805	0.001208	-	-	-	-	-	0.000481	0.000232	-	0.000665	**0.000632**

5.3 Required Labor for Salvaged Materials

Deconstruction												
MATERIALS	**UNITS**	**REMOVAL**	**1ST MANIPULATION**	**2ND MANIPULATION**	**STAGING**	**LOADING**	**MINUTES**	**CLOCK HOURS**	**WORKERS**	**DAYS**	**COMMENTS**	**CONCLUSIONS**
Carpet Tiles (SF.)	10,000	Scraping: 3 workers	Sorting: 1 worker	Palletizing	Moving: 0.5 worker	Forklift: 0.5 worker	-	N/A	5	2	For 100,000 SQF, 50 workers for 3~4 days. OR 5 workers for 20 days.	10 workerdays /10,000 SQF.
Doors (#)	100	300 minutes (3 mins./door)	500 minutes (hinges & lockets): 5 minutes/door	200 minutes (20 doors/pallet)	100 minutes (5 pallets to staging)	25 minutes (5 mins./pallet)	1125	19	2.3	1	100 doors with 20 doors per pallet requires 2 workers 1 day.	2.5 worker-days /100 doors
Kitchen Cabinets (#)	20	200 minutes (20 mins./cabinet)	60 minutes (3 mins./sink)	60 minutes (3 mins./cabinet x 15 pallets)	300 minutes (20 minutes/ pallet x 15 pallets)	65 minutes (5 mins. pallet x 15 pallets)	685	11.4	1	1.43	This job only requires one worker.	1.5 worker-days /20 cabinets
Sinks (#)	30	180 minutes (6 mins./sink)	90 minutes (3 mins./sink)	90 minutes (3 mins./sink x10 sinks/pallet	60 minutes (20 mins./pallet x 3 pallets)	15 minutes (5 mins./pallet x 3 pallets)	435	7.3	1	0.91	This job only requires only worker.	1 worker-day /30 sinks
Light Pendants (#)	10	50 minutes (5 mins./light)	30 minutes (3 mins./light)	30 minutes (3 mins./light)	20 minutes (20 mins./pallet)	5 minutes (5 mins./pallet)	135	2.25	2	0.28	Two workers required due to handling of fixture from ladder worker to another who wraps and palletizes.	1 worker-day /10 lights
Bathroom Partitions (#)	3 stalls	135 minutes (45 mins./overhead frame + 1 wall + 1 door)	30 minutes (10 mins./stall)	15 minutes (5 mins./stall)	20 minutes (20mins./pallet)	5 minutes (5 mins./pallet)	200	3.3	2	0.42	Assume 3 stalls in 1 bay and each stall has 1 door + 1 panel + frame.	1.5 worker days /3 stalls

POSITION	ANNUAL WAGE	CLOCK HOURS	WORKERS	COMMENTS
Deconstruction				
Manager		8	1	1 site manager for every 8-hour shift every day there are crews on site.
Lead Supervisor		8	1	1 site supervisor for every 8-hour shift every day there are crews on site.
Surveyor (Non-Contractor)	$60,000	-	-	Likley a employee of the permanent yard.
Floating Yard: 3 full-time workers during deconstruction, unburdended.				
Manager	$75,000	8	1	
Forklift Operator	$45,000	8	1	
Data Collector and Tag	$60,000	8	1	This could be a trainee position.
Permanent Yard / Warehouse: Full-time workers depending on days & hours				
Manager	$75,000	8	1	
Assistant Manager	$60,000	8	1	
Forklift Operators	$90,000	8	1	One position could be a trainee.
Inventory and Administration	$60,000	8	1	This could be a trainee position.
Yard and Sales	$16~24,000	8	4~6	Purely dependent upon customer traffic and number of sales.

NOTE:

Refurbishment will not be included on site due to the following reasons:

- Storage facility needs minimal infrastructure; paved, covered, loading docks, 110V power, minimal office, scales
- Refurbish facility needs more infrasturcture than a storage faciltiy: 220V power (versus 110V), testing equipment, dust control, locker rooms, substantial lighting, and hazmat materials storage.
- Refurbished materials would be in limited quantity, with the sale being to primarily smaller local buyers, requiring more of a retail space, than a storage yard, and not having the economies of scale to be sustainable.

5.4 Budget Details

1
SITE IMPLEMENTATION

TYPICAL SITE MATERIALS LIST						
				Total Cost		
Item	Unit	Unit Cost Base	Unit Cost Loaded	Model A 1.5 Acre 65,340 SF.	Model B 1.0 Acre 43,560 SF.	Model C 0.5 Acre 21,780 SF
SITE WORK						
Fencing with Printable Privacy Screen Cover	LF.					
Fence Repair Allowance		$40.00	$64.51	1026 LF. $66,189	836 LF. $53,932	592 LF: $38,191
8x24 Gate				$1,935	$1,935	$1,935
Privacy Screen		$5.00	$8.06	$8,274	$6,742	$4,774
Gate Locks	#	$89.00	$143.54	$287	$287	$287
Materials Weather Protection (Tent Covering or Other)	SF	$20.00	$32.26	36,000 SF. $1,161,216	26,000 SF $838,656	14,000 SF $451,584
Site Lighting Allowance	SF	$12.50	$20.16	$1,317,254	$878,170	$439,085
Trailer Installation				$25,740	$25,740	$25,740
Asphalt Patching and Repair	SF	$2.00	$3.23	$210,761	$140,507	$70,254
Parking Stall Stripping / Signage	LS			$8,064	$5,645	$5,645
UTILITIES						
Security Alarm System	LS			$104,832	$80,640	$56,448
Site-wide Wi-Fi Access	LS			$48,384	$40,320	$32,256
Convenience Power Allowance	SF	$2.50	$4.03	$263,451	$175,634	$87,817
PG&E Service (Allowance if Needed)	LS			$927,360	$927,360	$927,360
Cost Estimate Total				**$4,143,747**	**$3,175,567**	**$2,141,376**
Soft Costs (Design, Permitting, Etc.)	**25%**			**$1,035,937**	**$793,892**	**$535,344**
				$5,179,684	**$3,969,459**	**$2,676,719**

ASSUMPTIONS:

- Site is assumed to be paved and level (demo, clearing and grading of site are not required).
- Plumbing and sewer connections will not be modified.
- Actual PG&E service upgrade costs are unknown.
- Costs include design and construction contingencies, and all contractor markups.

5.4 Budget Details

2
SITE OPERATIONS

General Expenses Without Purchased or Leased Assets Which Change Depending Upon Site			Model A	Model B	Model C
BRIC Operating Expenses	**Annual**	**Comments**	**65,340 SF.**	**43,560 SF.**	**21,780 SF.**
Bank Charges	$300	Based on TRP	$300	$300	$300
Certifications and Training	$1,000	Safety, forklift, HR	$-	$-	$-
Community Outreach	$10,000	Budget estimate	$10,000	$10,000	$10,000
Credit Card Fees & Rental	$-	1.3% of sales	$-	$-	$-
Depreciation		Capital Purchases (See Schedule)	$220,155	$170,613	$118,752
Employee Welfare	$-	None budgeted	$-	$-	$-
Disposal Fees	$10,800	$900/ month	$10,800	$10,800	$10,800
Equipment Lease		Bathrooms, fencing, offices	$65,216	$65,216	$65,216
Freight	$-	None budgeted	$-	$-	$-
Fundraising	$-	None budgeted	$-	$-	$-
Insurance - Liability	$15,000	Based on TRP	$15,000	$15,000	$15,000
Insurance - Medical	$14,400	$400/mo./employee based on 50/50share and Kaiser	$14,400	$14,400	$14,400
Insurance - Vehicle	$-	None budgeted	$-	$-	$-
Interest	$-	None budgeted	$-	$-	$-
Licenses & Permits	$500	City license	$500	$500	$500
Maintenance & Repairs	$800	Based on TRP	$800	$800	$800
Office Supplies	$3,000	Based on TRP	$3,000	$3,000	$3,000
Rent	$-	None budgeted	$-	$-	$-
Telephone	$1,000	Based on TRP	$1,000	$1,000	$1,000
Tools & Supplies	$3,000	Guestimate, maintenance, fuel for forklift, tools	$3,000	$3,000	$3,000
Travel	$-	None budgeted	$-	$-	$-
Truck Fuel	$-	None budgeted	$-	$-	$-
Utilities	$6,000	Electric - based on TRP	$6,000	$6,000	$6,000
Wages - Burdened					
Labor	$45,000	Forklift operator $45,000/yr	$45,000	$45,000	$45,000
Management	$75,000	Manager = $75,000/yr	$75,000	$75,000	$75,000
Office	$60,000	Data collection and bookkeeper = $60,000/yr	$60,000	$60,000	$60,000
Payroll Taxes	$13,500	9% times total wages	$13,500	$13,500	$13,500
Insurance - Worker's Comp	$30,000	20% of total wages	$30,000	$30,000	$30,000
Total Wages - Burdened	$223,500		$223,500	$223,500	$223,500
Total Retail Expenses	**$289,300**		**$573,671**	**$524,129**	**$472,268**

NOTES:
- Labor costs are based on a 40 hour work week.
- Existing fencing and paving is assumed to be adequate.

[1] Pallet jacks, wrapping equipment
[2] Electric forklifts (quote from Toyota)
[3] Assume Rheaply

Schedules for Yearly Depreciation and Lease/Rental Costs Depreciation for Site Improvements			
	Model A	**Model B**	**Model C**
	65,340 SF.	**43,560 SF.**	**21,780 SF.**
Site Improvements	$4,143,747	$3,175,567	$2,141,376
Annual Depreciation (20 year)	$207,187	$158,778	$107,069
Depreciation for Non-site Assets			
Containers, Equipment & Rolling Stock			
Containers	$12,500	$7,500	$7,500
Pallet Racks	$5,000	$5,000	$5,000
Equipment [1]	$6,380	$6,380	$6,380
Rolling stock [2]	$70,951	$70,951	$70,951
Total	$94,831	$89,831	$89,831
Annual Depreciation (10 year)	$9,483	$8,983	$8,983
Software Development [3]	**$-**	**$-**	**$-**
Annual Depreciation (5 Years)	$-	$-	$-
Computers	**$3,027**	**$3,027**	**$3,027**
Annual Depreciation (5 Years)	$605	$605	$605
Furniture			
Chairs, desks	$6,703	$5,498	$5,498
Shelving	$1,539	$1,026	$1,026
Recycle bins	$116	$116	$116
Furniture & Appliances	$6,035	$4,591	$3,834
Total	**$14,393**	**$11,231**	**$10,474**
Annual Depreciation (5 years)	$2,879	$2,246	$2,095
Total All Annual Depreciation	$220,155	$170,613	$118,752
Lease/Rentals			
Lease (2 office trailers & 1 bathroom)	$65,216	$65,216	$65,216
Rent fencing, gates and screen	$-	$-	$-
Total Rent/Lease	**$65,216**	**$65,216**	**$65,216**

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