Market Analysis of Construction and Demolition Material Reuse in the Chicago Region

Rachel Weber, Susan Kaplan, and Hannah Sokol
College of Urban Planning and Public Affairs
Institute for Environmental Science and Policy
University of Illinois at Chicago

January 9, 2009

Commissioned by the Delta Institute and funded through a grant from the Illinois Department of Commerce and Economic Opportunity

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Executive Summary

We analyze the market for construction and demolition (C&D) material reuse in Chicago in order to determine whether one or more reuse stores could be supported in the region. We estimate the current size, composition, and geography of the supply and demand for C&D material. We also identify obstacles to the reuse of C&D materials, discuss "best practices" adopted in other parts of the country, and suggest public policies and market practices that could increase deconstruction and demand for used C&D materials. Throughout the study our focus is on *building-related* C&D materials, as opposed to those generated by public infrastructure and roadway projects, and on those generated from *residential*, as opposed to commercial, projects.

Using permit data and widely-accepted conversion algorithms, we estimate that the total residential C&D materials generated in the city of Chicago in 2007 was approximately 742,305 tons, the bulk of which were generated from building renovation as opposed to new construction or demolition. Suburban municipalities where household income or environmental consciousness are high enough to make property owners there candidates for deconstruction and building materials donations generated another 20,386 tons of C&D materials in 2007 from construction and demolition only.

The primary sources of large-volume demand for these materials include landfills and transfer stations as well as recycling facilities. As of January 1, 2007, there were 48 active, state-certified landfills in Illinois, nine of which were located in the Chicago region. Eight of the nine active landfills reported decreased capacity, and the only one reporting increased capacity accepts debris generated solely in Will County. There are approximately 31 recycling and reclamation facilities for different kinds of C&D materials located in the city of Chicago with another 40 located in other municipalities in Cook County. Factors influencing whether C&D materials are recycled, reused, or landfilled include the presence of well-developed secondary markets for the recycled by-product (e.g., scrap metal, crushed-concrete fill), the degree to which the material can be easily sorted, separated, and cleaned, and the existing regulatory environment. C&D material reuse appears to be taking place only on a very small-scale (as part of higher-end architectural and historical salvage operations) or on an informal basis.

To determine the potential demand for used building materials, we gathered information from reuse stores in other parts of the country about their typical customers. The reuse customer base is comprised primarily of those individuals who want to upgrade their owner-occupied or investment properties, own older properties, are income-constrained, and are recent immigrants. Based on this profile, we ranked communities within the Chicago region on the basis of these indicators. Twenty-one Chicago Community Areas, which clustered in three specific parts of the city, were identified as "hot spots" of potential building material reuse. Several inner-ring and north-western suburbs were also identified as areas of potentially strong demand. If even one percent of the declared value and square footage for construction and renovation activity in these areas could potentially be purchased used, this would create consumer demand of $3.5 million or 878

tons of used building materials. The Kansas City ReStore, a 35,000 square foot reuse facility, conducted $1.6 million in sales activity, moving approximately 2,609 tons of product in 2007. In order to generate the volume of materials necessary to support a reuse store the size as the one in Kansas City, approximately 21 houses (at the suburban average of 2,262 square feet), or ten percent of the number of demolitions conducted in our sample suburbs, would need to be deconstructed. Combined, these measures lead us to believe that a sufficient market currently exists to support reuse store roughly equal in size to that of Kansas City conveniently located along a major arterial or expressway in one of the three hot-spot clusters. Demand is likely to grow as environmental consciousness grows, new building materials become more costly, and household incomes (and therefore construction budgets) become increasingly constrained.

Despite current and potential demand, several barriers currently inhibit the development of an active market for used C&D materials in the Chicago region. These include relatively low tipping fees for regional landfills and transfer stations, the lack of a grading system for used lumber, concerns about materials contamination, and the lack of differentiation between demolition and deconstruction in the often lengthy permitting process.

Local governments could do much to incent building deconstruction and the reuse of salvaged materials – particularly by upgrading existing regulations and programs. For example, the City of Chicago and other municipalities in the region could offer a new deconstruction permit that would be quicker and less expensive to obtain than a conventional demolition permit. Municipalities could also award points for deconstruction and reuse activities in bids for public projects. Public requirements may include restricting C&D debris from landfills, requiring pre-demolition salvage periods, or requiring construction waste management plans for all demolition permits. Local governments and the State of Illinois could also provide or support the education, information exchange, and technical assistance necessary to build this market. This could include providing a “waste exchange” service, model diversion ordinances, sample specifications, and a waste management plan template; offering site visits to evaluate diversion options; and conducting research on reuse options for hard-to-recycle commodities.

Acknowledgements: The authors wish to thank the following individuals for their advice, assistance, and insight: Yochai Eisenberg, Milan Kluko, Max Dieber, Nina Savar, Daniel McMillen, Shoshana Lenski, Ben Nwigwe, Suzanne Lanyi Charles, Brian Alferman, Ted Reiff, Dave Hampton, Julie Gevrenov, and Tom Napier.

About the Authors

Rachel Weber is an Associate Professor in the Urban Planning and Policy Program at the University of Illinois at Chicago and is a nationally recognized expert in the field of real estate finance, particularly the design and effectiveness of financial incentives for urban redevelopment. Dr. Weber is the author of numerous articles and reports on financial incentives, the most recent of which have focused on the increasing use of Tax Increment Financing (TIF) in American cities. She has also conducted research into the incidence of demolition and is working on a book manuscript that explores the connection between overbuilding and obsolescence during the last commercial construction boom. Dr. Weber has served as a consultant to local governments, developers, and community organizations across the country on issues related to TIF, business retention and attraction, and public finance. She received her master's degree and doctorate in City and Regional Planning from Cornell University and bachelor's degree from Brown University.

Susan Kaplan develops and conducts research and outreach activities at the Institute for Environmental Science and Policy at UIC, with a focus on brownfields, sustainable development, environmental health, and waste reduction. Prior to coming to UIC, she managed the brownfields program at the Rhode Island Economic Development Corporation, where she applied for and administered brownfields assessment and cleanup revolving loan fund grants from U.S. EPA, assisting borrowers and subgrantees in meeting underwriting, community outreach, and environmental requirements for loans and subgrants. She also conducted policy research, analysis and writing on brownfields and sustainable development issues. Her report analyzing options for making environmental insurance more accessible and affordable to developers was distributed to all members of the Rhode Island General Assembly, and she wrote the application nominating the winning project of the 2005 Phoenix Award for EPA Region 1. Prior to the brownfields position, she served as assistant director of the Harvard Electricity Policy Group at Harvard's Kennedy School of Government, and was a staff attorney developing safety and health regulations in Washington, DC. Kaplan serves on the Evanston Environment Board, which advises the Evanston, IL City Council on environmental policy. She is also a longtime freelance writer of articles, opinion pieces and essays for national-circulation newspapers and magazines. She holds a J.D. from the University of Wisconsin.

Hannah Sokol is a candidate for a master's degree in Urban Planning and Policy from UIC's College of Urban Planning and Public Affairs. She is interested in sustainable urban development with particular attention to economic policies and incentives encouraging the broader adoption of green development. She recently worked on the EPA Region II project: Market Barriers to Green Development. She received her bachelor's degree from Earlham College.

I. Introduction

The bulk of the waste stream in the United States is comprised of materials produced through building and demolition activity. Over 160 million tons of surplus construction and demolition (C&D) materials are generated each year in the United States and by some accounts, 60 percent of these are sent to landfills (Chini and Bruening 2003). These materials include wood products, such as clean scrap lumber; brick and block; gypsum wallboard; manufactured wood (plywood); cardboard; asphalt shingles and pavement; metals (pipes, wire, conduits, beams); plastics; concrete; dirt; and salvageable appliances, ornaments, and fixtures.

The large volume of C&D materials in the waste stream is a matter of serious concern given the associated environmental and economic risks. First, it is unhealthy. C&D landfills can emit gasses that raise an array of health and safety issues (Colledge 2008).

Second, it is inefficient. Increasing tipping fees and scarcer opportunities to dump mean that these heavy materials must be transported farther away from their place of origin. Moreover, new building materials and appliances are being manufactured in more remote locales and imported from further distances. These long-distance trips increase fuel consumption and carbon emissions and also raise prices for consumers.

Third, it is unsustainable. Disposing of any product destroys its embodied energy – the energy consumed in acquiring its inputs and manufacturing, transporting, using and maintaining it. Moreover, if that commodity has use and exchange values which are not being realized, consumers experience a loss. In contrast, reusing a commodity maintains its "embodied energy", integrity and value while keeping it out of the waste stream. Not even recycling can claim such benefits as recycling consumes energy and creates pollution in the process of converting one product into another. Materials are generally made less valuable when their basic form is modified.

Fourth, it is discriminatory. Landfills and unpermitted dump sites are often located in low-income and minority neighborhoods. In the city of Chicago, for example, the 80-foot high "Mountain" of illegally dumped C&D waste in the neighborhood of North Lawndale came to symbolize the corruption and environmental degradation suffered by the city's poorest neighborhoods. Grassroots responses to these injustices helped to catalyze a local movement for environmental justice out of which strategies for the reuse of C&D materials have emerged.

To significantly divert C&D materials from the fast-moving waste stream, a region needs two sets of intermediaries that together comprise the core infrastructure for reuse. The first prevents materials from ending up in the dumpsters at job sites. "Deconstruction" is an alternative to the conventional demolition process that is slowly gaining purchase. Deconstruction contractors preserve building materials by carefully removing them in a way that maintains their integrity and allows for their resale. The second set of intermediaries connects the salvaged products with final consumers, building up a market

for the used products. Reuse stores across the country warehouse and resell these commodities, accessing and educating consumers while recovering materials for resale to support their operations.

The following study analyzes the market for deconstruction and C&D reuse in the Chicago region, with a focus on determining whether the market area could support a reuse center. In this study, we estimate the current size, composition, and geography of the supply and demand for C&D materials in the city of Chicago and select suburban municipalities. We also analyze the market and policy obstacles to the reuse of C&D materials, identify "best practices" adopted in other parts of the country, and suggest public policies and institutional practices that could increase demand for used C&D materials. Throughout the study, our focus is on *building*-related C&D materials, as opposed to those generated by public infrastructure and roadway projects, and on those generated from *residential*, as opposed to commercial, projects.

II. Estimating the Size and Location of the Supply of Construction and Demolition Materials

The City of Chicago

Used building materials are produced through three different but inter-related processes: construction, remodeling, and demolition. Collectively, these industries experienced a boom of significant proportion between 1996 and 2006. Fueled by low interest rates, new debt products, and expanded consumer demand, the value of residential construction in the United States rose from $5.4 trillion in 2000 to $8.1 trillion in 2005 (U.S. Census Bureau, 2007).

The Chicago region was the recipient of much of this new investment in the built environment. An estimated 100,000 residential contractors (including specialty trades, such demolition contractors, and sole proprietorships) operated in Chicago Metropolitan Statistical Area in 2003 (Doussard 2008). In the Chicago region, as in the United States as a whole, the majority of residential contractors are small, sole proprietors and employ no more than one or two workers.

We obtained address-level information for every construction, renovation, and wrecking permit issued by the City of Chicago's Department of Buildings for the period between 2005 and 2007. This data set contains information on the building address, date of permit issuance, and declared value for every legal permit issued by the City of Chicago over this period. These data reveal that contractors in the city applied for an average of 12,820 permits for each year between 2005 and 2007, a period during which the total number of permits increased by over 20 percent (see Table 1). The value of these permits averaged close to $7 billion a year for the three-year period.

Table 1: Residential Permits Issued by the Chicago Department of Buildings, 2005 through 2007

		Total Records	Percent Total	Total Declared Value	Percent Total
2005	Building	3,063	26.90%	$3,940,749,584	65.81%
	Renovation	6,683	58.70%	$2,002,069,868	33.43%
	Wrecking	1,639	14.40%	$45,337,578	0.76%
	Total	11,385		$5,988,157,029	
2006	Building	3,381	25.36%	$4,451,891,383	54.56%
	Renovation	8,498	63.74%	$3,664,546,849	44.91%
	Wrecking	1,454	10.91%	$43,519,480	0.53%
	Total	13,333		$8,159,957,711	
2007	Building	2,502	18.21%	$4,449,787,042	68.04%
	Renovation	9,868	71.80%	$2,021,306,402	30.91%
	Wrecking	1,373	9.99%	$68,747,046	1.05%
	Total	13,743		$6,539,840,491	

Source: City of Chicago Department of Buildings

Most accounts of the last boom tend to emphasize the number of new housing starts. However, in many older cities, remodeling and renovation growth outstripped overall rates of residential housing growth for this period. Remodeling and renovation may include such varied activities as additions, alterations, roof and deck replacements, HVAC system replacement, and driveway installation. In 2002, remodelers accounted for 15 percent of residential construction work nationally, but residential remodeling expenditures grew steadily: from 2004 through 2007 alone, these expenditures increased by nearly 50 percent. In the city of Chicago, renovation permits accounted for more than twice the number of construction permits during the tail end of the boom. Over the three-year span for which we have data, the total number of residential remodeling permits grew by 45 percent.

On a per-unit basis, demolition contractors produce most C&D waste. While most associate the wrecking ball and explosives with the demolition process, the majority of demolitions are much smaller in scale, and contractors use handtools such as jackhammers to dismantle buildings (Weber, Doussard, Bhatta, and McGrath 2002). Nonetheless, conventional demolition techniques tend to irreparably damage materials, leaving them in worse shape than the construction and renovation processes. Rules require wreckers to cart off the remains of the structures demolished and to leave behind a graded, empty lot. In Chicago, approximately 1,500 residential demolition or wrecking permits were issued in each of the years between 2005 and 2007. However, it is important to note that the Chicago Department of Buildings estimates that 1 out of every 5 demolitions in the city takes place illegally, i.e., without proper permits (Kamin and Reardon 2003).

Not all municipalities or neighborhoods experienced this housing development boom. Permits were distributed across Chicago in an uneven manner, implying that some areas are more prolific sources of C&D materials than others. The following maps of Chicago community areas by total number of permits and declared value reflect a variegated geography (see Figures 1, 2 and 3). The bulk of construction and renovation activity occurred in the neighborhoods ringing the Central Business District and on the city's higher-income North Side. Demolition activity was more dispersed, concentrating in areas of redevelopment (Lakeview, West Town) but also occurring on the city's far west side and in the south-central band of high-poverty neighborhoods moving south from Pilsen and the Near West Side. The latter may be "nuisance demolitions" where the City orders the destruction of the buildings to rid the neighborhood of abandoned, hazard-attracting structures.

Figure 1: Total Building, Renovation, and Demolition Permits by Chicago Community Area, 2005-2007

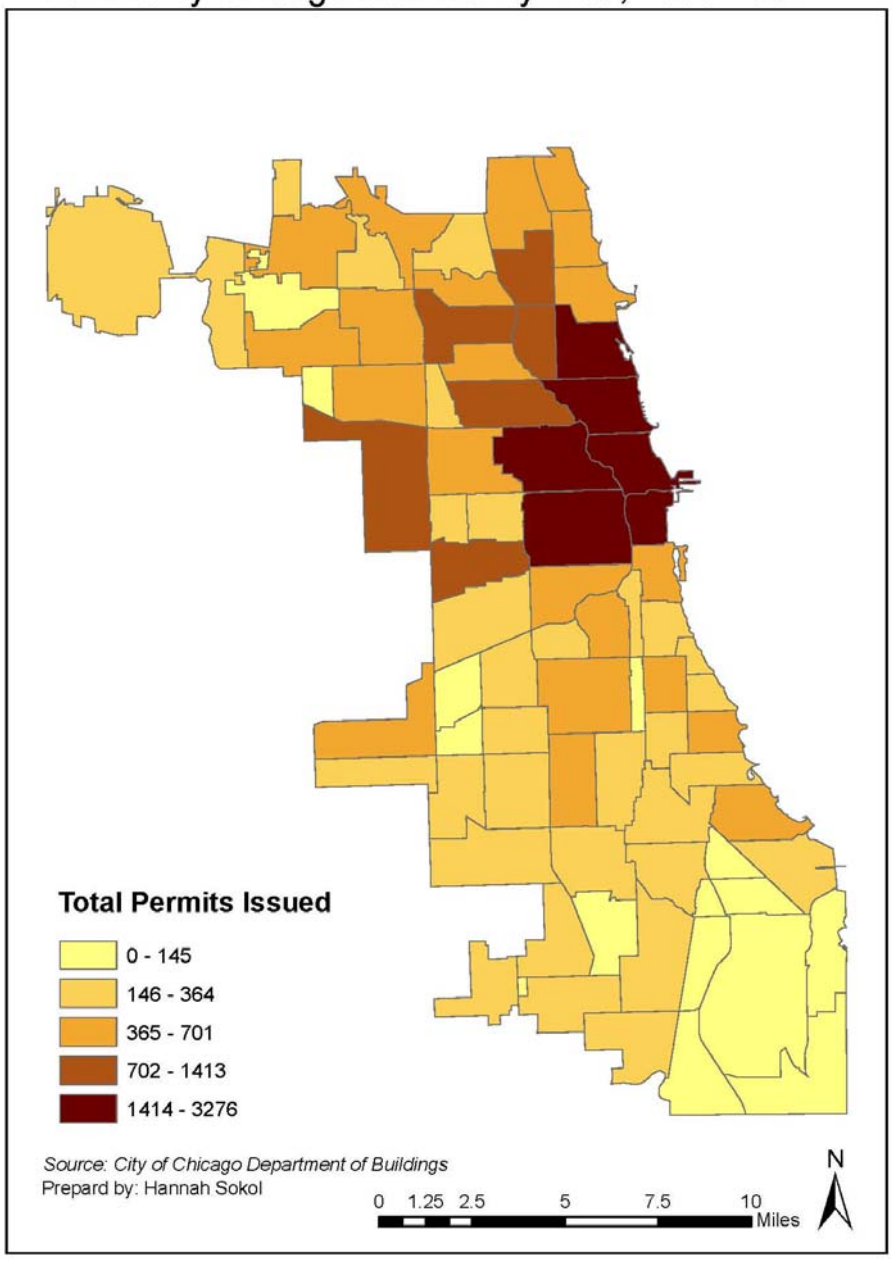


Figure 2: Total Declared Value of Residentail Building and Renovation Permits by Chicago Community Area, 2005-2007

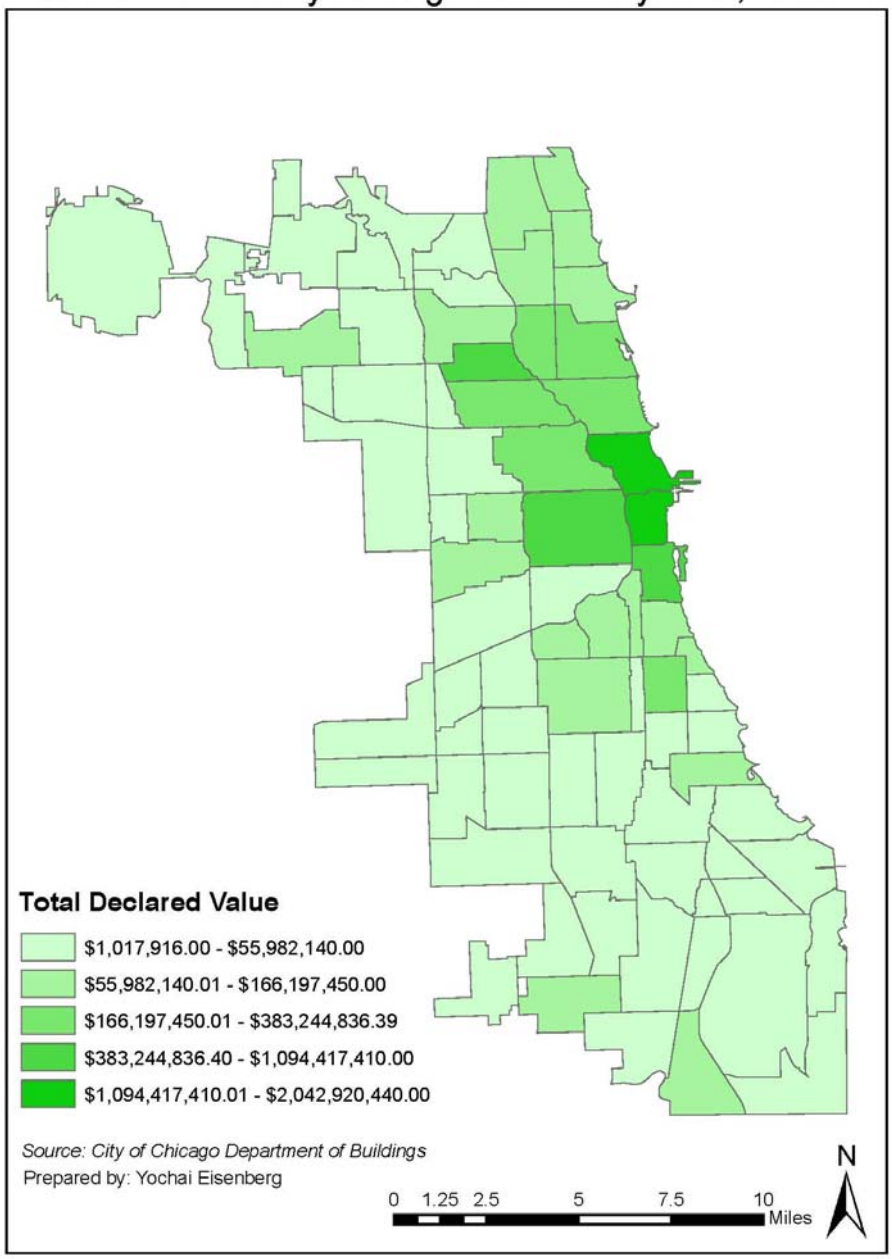
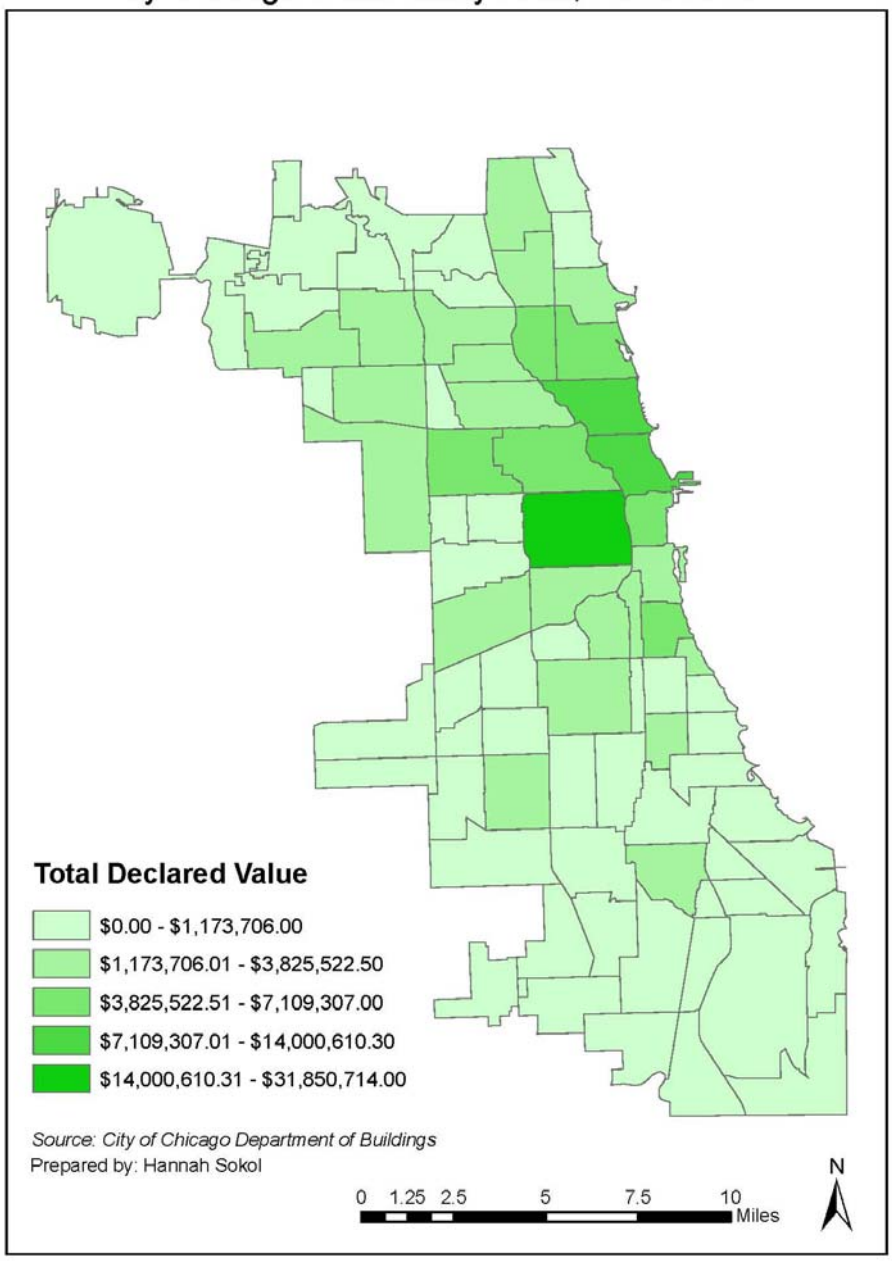


Figure 3: Total Declared Value of Demolition Permits by Chicago Community Area, 2005-2007



The supply of C&D materials produced through these three building processes can be estimated by analyzing current building and demolition activity in the area. Of course, residential construction is characterized by its uniqueness. Even when they are built from the same blueprint, differences in location, building material quality, upkeep, and modification produce structures that differ in large ways and small. As such, the surplus materials produced through these processes are themselves highly heterogeneous. The amount of waste produced by one contractor may differ significantly from that produced by another, due primarily to the level of expertise or training of employees.

Although there are several methods used to estimate C&D generation, most -- particularly those that survey waste disposal and recycling facilities -- rely on data that are unavailable for the Chicago region. As such we follow the lead of studies such as Yost and Halstead (1996) and Cochran et al. (2007) in estimating sector activity and applying an appropriate waste production rate for that activity. Specifically, we apply established algorithms to the total area of new construction, remodeling, and demolition permits in the study area to convert the amount of square footage of these activities into a volume of C&D materials generated from them.

The algorithms are based on the EPA's 1998 study, "Characterization of Building-Related Construction and Demolition Debris in the United States" prepared by Franklin Associates. The study relied on point source waste assessments, i.e., the sampling and weighing of materials at construction and demolitions sites, to provide average per square foot debris generation rates. Because waste yields varied by the type of activity and the nature of the building project, the report presented generation rates in six categories: construction, renovation, and demolition debris for both residential and non-residential properties. As may be expected, building activity yields the lowest generation rates, renovation rates are higher, and demolition rates are highest when entire buildings are transformed into debris. We use the average generation rates for the multiple cities where the point source assessments were performed.

We apply these residential construction, renovation, and demolition generation rates to the corresponding total square footage data from the City of Chicago Department of Buildings permit data for 2007. We focus on permit data for 2007 because this year is potentially the most representative of future activity. The building cycle in Chicago is widely believed to have begun tapering off with the advent of the credit crisis in the summer of 2007. Previous years reflect the height or near-height of the boom, a phenomenon not likely to be replicated in the near term. We also focus on residential properties because C&D materials generated from commercial construction are often idiosyncratic, highly customized to particular processes, and therefore more difficult to reuse for the typical residential consumer.

Relying on these methods, we found that the estimated volume of total C&D materials generated in Chicago in 2007 based on residential permit data was 742,305 tons, the bulk of which were generated from building renovation (see Table 2).

Table 2: C&D Materials Generated in Chicago, 2007

	Construction			**Renovation**			**Demolition**		
	Total Sqft	Lbs p/sqft	Total. Yield: tons	Total Sqft	Lbs p/sqft	Total. Yield: tons	Total Sqft	Lbs p/sqft	Total Yield: tons
Single Family	2,637,712	4.38	5,777	2,845,184	23.17	32,961	1,010,368	111	56,075
Multi-Family	28,108,697	3.89	54,671	45,715,505	23.17	529,614	995,362	127	63,206
Totals			60,448			562,576			119,281
Estimated total amount: 742,305 tons									

Unfortunately, the majority of municipalities that form the basis for the EPA algorithms are smaller cities and suburbs, where house size tends to be larger than in Chicago. In other words, the algorithms available may overestimate the total debris yielded for the City of Chicago. However, many of our permit observations did not include occupancy codes to designate them as residential or non-residential, and so we did not include them in the building and renovation yields (see Appendix 1 for a description of the data cleaning process). In addition, a significant amount of renovation and demolition activity takes place without a permit, and so the total yield calculated may be underestimated. Combined, these flaws in the data and algorithms may cancel each other out.

We also compare these permit-based estimates to self-reported estimates of the amount of recyclable materials generated during the construction of larger (over four units) residential and commercial properties collected by the Chicago Department of Environment (DOE). As part of a city ordinance passed in 2005 that requires general contractors constructing, renovating or demolishing qualified projects to recycle at least 50% of recyclable debris generated by their operation, the DOE now requires that contractors complete C&D Recycling Compliance Forms. They request that contractors "estimate the volume of 'recyclable' debris generated at each job site" in addition to attesting to the amount that was actually recycled or reused. Recyclable debris does not include materials that are contaminated with lead, asbestos or other hazardous materials.

These data show that 520,050 tons of recyclable C&D materials were generated during 2007 (Department of Environment Recycling Compliance History, 2008). The bulk of C&D waste was generated during the months of April, May, and June, which is generally considered a good time to begin construction in a cold climate. Another study of Chicago, this one completed by the consultant CDM, estimated the total volume of C&D waste at 2,931,000 tons per year (an average for the years 2000 through 2003) (CDM 2006).

However, it is important to note that a large portion of the permits we analyzed would not fall under the C&D Recycling Compliance requirements. The ordinance does not apply to construction or demolition of smaller buildings or single-family houses. It is limited to construction of new residential buildings with four or more units; construction of new non-residential buildings of more than 4,000 square feet; demolition of residential buildings with four or more units that includes demolition of at least one outside wall; and demolition of non-residential buildings of more than 4,000 square feet. In contrast, smaller residential structures are comprised of less of the heavy materials that are easy to recycle (concrete, asphalt) but hard to reuse. This is one of the reasons why our estimates from the permit data exceed the self-reported volume of recyclable C&D materials. The CDM estimate is almost four times that of ours because it includes all commercial properties and non-building related C&D and is based on per capita population figures.

The composition of C&D debris generated varies by activity. Using the EPA's estimated composition in the categories of residential building, renovation, and demolition, we calculated an approximate volume of individual C&D materials based on the total estimated volume generated in Chicago in 2007. Table 3 shows the potential volume of materials generated in each of the three categories. While certain materials, such as concrete and plastics, are not suitable for reuse, the large percentage of wood debris generated in all three activities points to opportunities for such. Again, it is important to note that both regional as well as urban versus suburban differences in housing types influence the composition of materials generated. In Chicago we could expect to see clay bricks and concrete masonry units comprising an even larger share of the C&D debris than national averages would suggest.

Table 3: Predicted Composition of C&D Debris in Chicago

2007 Construction debris: tons				**2007 Renovation debris: tons**				**2007 Demolition debris: tons**		
Total tons		60,448		Total Tons		562,576		Total Tons		119,281
Material	Percentage*	Tons		Material	Percentage*	Tons		Material	Percentage*	Tons
Wood	0.42	25,388		Wood	0.45	253,159		Wood	0.42	50,098
Drywall	0.27	16,321		Roofing	0.28	157,521		Misc	0.32	38,170
Misc	0.15	9,067		Drywall	0.21	118,141		Concrete	0.24	28,627
Brick	0.06	3,627		Misc	0.06	33,755		Metals	0.02	2,386
Roofing	0.06	3,627		Metals	0.01	5,626				
Plastics	0.02	1,209								
Metals	0.02	1,209								

*Source: EPA 1998

Chicago suburbs

Because our interviews revealed that the majority of households that donate building materials for reuse and that opt for deconstruction over demolition live in large homes and have high incomes, we also investigated the potential supply of C&D materials in a select number of Chicago suburbs. The sample of suburbs was based on those where municipal median incomes were high enough so that households there would be in the 28 percent tax bracket and would itemize donations to calculate their total tax deductions. Income tax deductions for donations of building materials are one of the few incentives

that currently exist to supply C&D materials to secondary markets. This median income figure was estimated to be $168,000 for a household of four in 2007. Two other suburban municipalities that did not approach the median incomes requirement -- Oak Park and Evanston -- were nonetheless added to the sample because of the high levels of environmental awareness among residents (as evidenced by voting records for Green Party candidates and prior incidence of deconstruction) and the large number of single-family homes.

Table 4: Median Income by Cook County Municipality, 2000

	Total population: 2000	Median household income (in 1999 dollars)
Barrington Hills	3915	$145,330.00
Burr Ridge	10408	$129,507.00
Evanston	74239	$56,335.00
Glencoe	8762	$164,432.00
Golf	451	$131,742.00
Hinsdale	17349	$104,551.00
Inverness	6749	$141,672.00
Kenilworth	2494	$200,001.00
Northfield	5389	$91,313.00
Oak Brook	8702	$146,537.00
Oak Park	52524	$59,183.00
South Barrington	3760	$170,755.00
Wilmette	27651	$106,773.00
Winnetka	12419	$167,458.00

Source: U.S. Census 2000

We collected construction permit data for each of the fourteen suburbs from the U.S. Census and, based on the average size of suburban single- and multi-family homes, applied similar conversion algorithms to convert building area into volume of C&D materials. We acquired demolition permit data for 8 suburbs (Evanston, Glencoe, Golf, Kenilworth, Northfield, Oak Park, Wilmette, and Winnetka) and calculated an average residential demolition rate (number of demolitions/total housing units). Applying this rate to the number of housing units in the other municipalities, we estimated both the number of demolitions occurring annually as well as the total square footage of houses demolished. These figures were also converted into tons of C&D materials based on the EPA algorithms. Unfortunately, data recording renovation permits for the suburban municipalities were not available.

Table 5 estimates the volume of C&D materials generated by construction and demolition activities within the municipalities that comprise our suburban sample in 2007. Suburban municipalities where household income or environmental consciousness are high enough to make households there candidates for deconstruction and building materials donations generate approximately 20,386 tons of C&D materials per year. Again, it is important to note that we lack information on renovation, whose per-unit incidence is likely to be greater than in the city. As such, these figures underestimate the volume of potentially reusable materials supplied in the suburbs.

Table 5: C&D Materials Generated from Construction and Demolition in Sample of Chicago Suburbs, 2007

	Building Permits 2007	Total Bldng in Sqft	Weight* in tons	Predicted Demolition Permits 2007	Total Demo Sqft	Weight** in tons
Barrington Hills	11	24882	54	6	9962	573
Burr Ridge	30	67860	149	15	24530	1,410
Evanston	16	36192	79	22	35400	2,024
Glencoe	34	76908	168	8	12800	736
Golf	0	0	-	1	1600	92
Hinsdale	43	97266	213	27	42763	2,459
Inverness	71	160602	352	10	15597	897
Kenilworth	7	15834	35	7	11200	644
Northfield	1	2262	5	7	11200	644
Oak Brook	17	38454	84	14	21675	1,246
Oak Park	35	79170	173	6	9600	552
South Barrington	71	160602	352	5	8006	460
Wilmette	30	67860	149	44	70400	4,048
Winnetka	24	54288	119	29	46400	2,668
Totals			1,932	201		18,454
Estimated total C&D materials: 20,386 tons						

Source: U.S. Census 2007

**NAHB average new single family home size (Mid-West):2,262 sqft*

***EPA average single family demolished size: 1,600 sqft*

We expect that deconstruction would be most attractive to households that can take advantage of the tax deduction benefit, i.e. those households with incomes over $168,000. Table 6, using 2000 U.S. Census data, shows that approximately 115,000, or nearly 6%, of households in Cook County would be eligible for the tax benefits from deconstruction.

Table 6: Household Income, Cook County 2000

Cook County, Illinois

Total Households	1,974,408

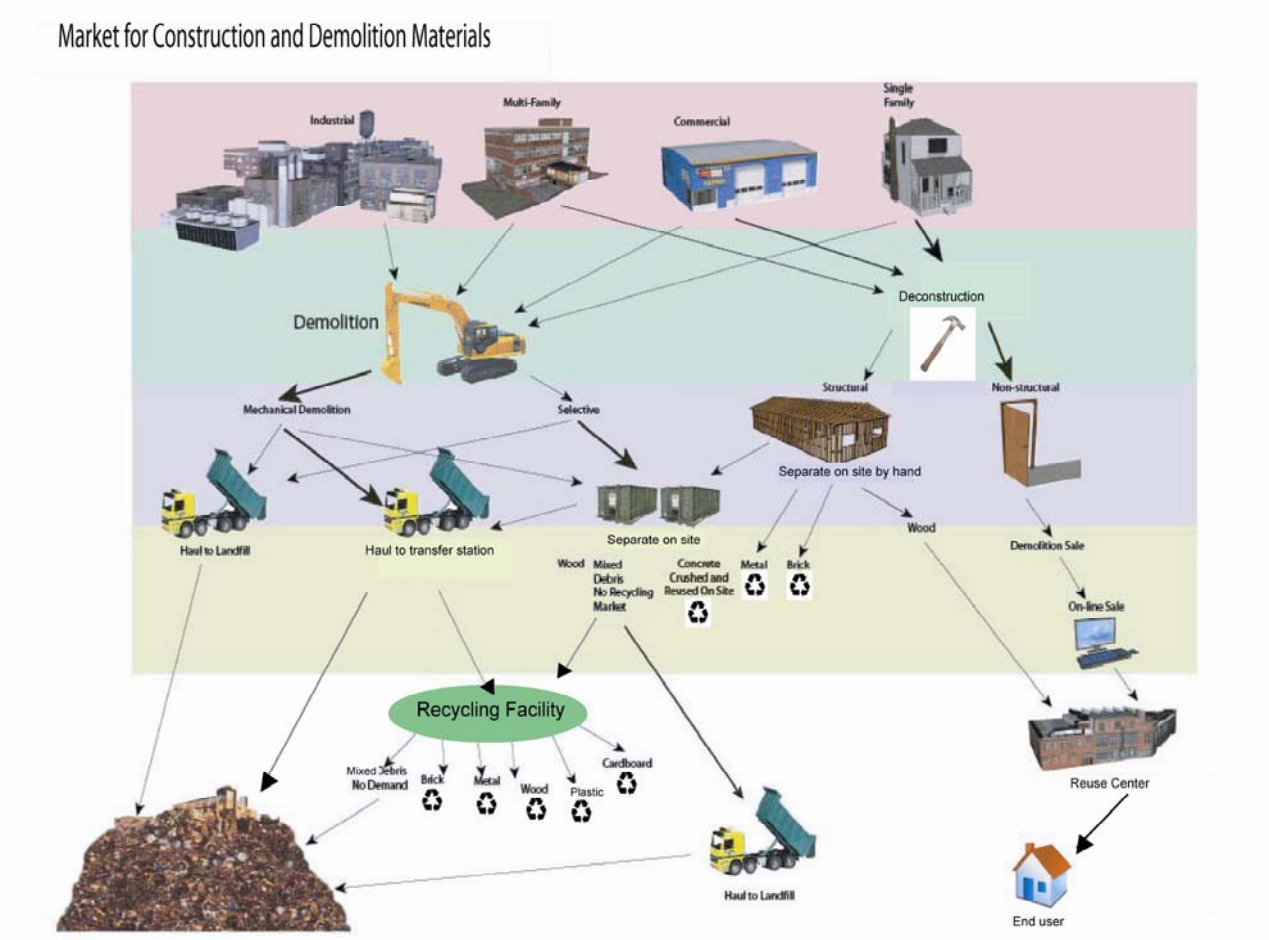
Income	**Households**	**Percent Total**
Less than 10,000	192,689	9.76%
$10;000 to $14;999	107,043	5.42%
$15;000 to $19;999	104,713	5.30%
$20;000 to $24;999	111,195	5.63%
$25;000 to $29;999	112,837	5.71%
$30;000 to $34;999	117,950	5.97%
$35;000 to $39;999	111,805	5.66%
$40;000 to $44;999	109,361	5.54%
$45;000 to $49;999	95,409	4.83%
$50;000 to $59;999	177,254	8.98%
$60;000 to $74;999	213,525	10.81%
$75;000 to $99;999	222,453	11.27%
$100;000 to $124;999	122,128	6.19%
$125;000 to $149;999	59,810	3.03%
$150;000 to $199;999	53,986	2.73%
$200;000 or more	62,250	3.15%

Source: U.S. Census 2000

III. Existing Demand for Construction and Demolition Materials

What are the conventional sources of large-volume demand for construction and demolition materials in the Chicago region? The markets for C&D materials are varied and use the materials in very different ways. Demand is conceived as stemming from final users/end markets (developers and contractors sourcing previously used materials as well as landfills) and the intermediaries that service them with such materials (haulers, recycling facilities, and reuse stores). In some cases, the recipients pay for materials in order to resell them to ultimate end-users (i.e., recycling facilities), while in others they charge a fee to the supplier for depositing them (i.e., landfills and tipping stations). The following diagram clarifies the typical flow of materials (Eisenberg 2008).

Figure 4: The Market for Construction and Demolition Materials



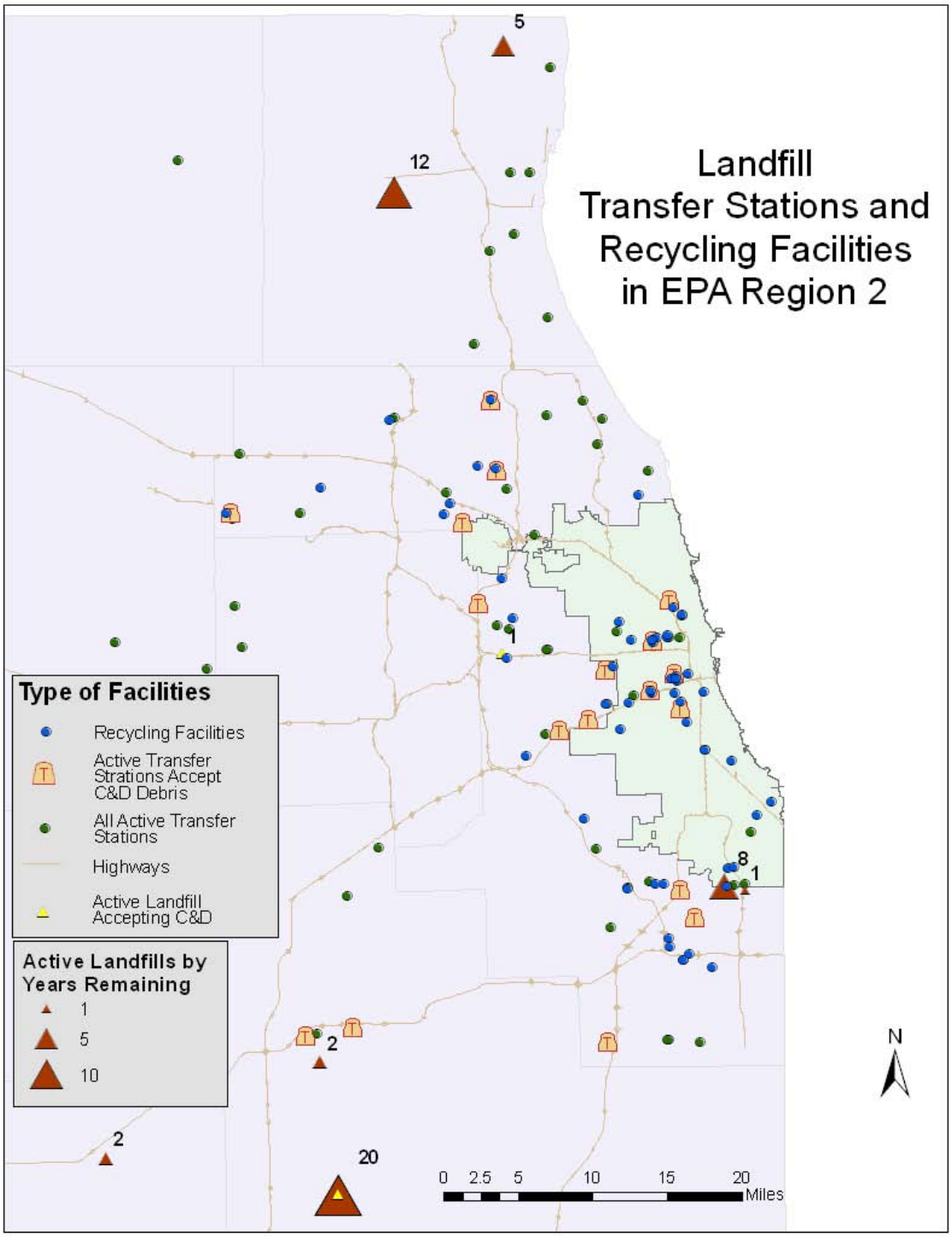
Source: Yochai Eisenberg 2008

Transfer stations and landfills

National studies have demonstrated that most C&D materials end up in certified landfills and unpermitted sites. The EPA estimates that 35 to 45 percent of C&D materials were discarded in C&D landfills, with another 30 to 40 percent managed on-site, at a "municipal solid waste" (MSW) landfill, or at an unpermitted site (EPA 1998). As such, the location, pricing, and sourcing practices of landfills and transfer stations heavily influence the other potential markets for C&D materials.

As of January 1, 2007, there were 48 active, state-certified landfills in Illinois, and 9 of these were located in the Chicago region (the "Chicago Metropolitan Area" or EPA Region 2 includes: McHenry, Lake, Kane, DuPage, Cook, Kendall, Will, Grundy, and Kankakee Counties; see Illinois EPA 2007) (See Figure 6). Eight of the nine active landfills reported decreased capacity, while one, Settler's Hill in Batavia, began its closure operations that year. Prairie View in Wilmington was the only landfill reporting increased capacity. At the beginning of 2007, 60 percent of the region's available capacity was located at this site, but it is owned by Will County and only accepts waste receipts from that county.

Figure 5: Landfills and Transfer Stations in Illinois EPA Region 2



Source: Yochai Eisenberg 2008

These landfills accept mixed MSW and non-hazardous waste, including non-contaminated C&D debris materials. Unless they increase capacity (approving permits for new landfills or for expansions of existing ones) or decrease disposal rates, the Chicago Metropolitan Region's landfills will be at capacity in eight years (EPA 2007). While the overall rate of waste received for the region has been declining steadily from 1996 to 2006, from 6.9 million tons to 3.7 million tons, there was a 6.7 percent increase in total waste received between 2005 and 2006 (see Table 7).

Table 7: Chicago Metropolitan Region Landfill Capacity 1996-2006

	Waste Received	Percent Change	No. of Active Landfills	Est. Capacity in Years	Percent Capacity Change
2006	3.7 million tons	6.7%	9	8	-3.9%
2005	3.5 million tons	-2.8%	10	9	-17%
2004	3.6 million tons	-3.9%	10	11	117.8%
2003	3.8 million tons	-11.2%	9	5	-19.2%
2002	4.2 million tons	-0.9%	13	5	-13.3%
2001	4.2 million tons	-1.7%	13	6	-7.8%
2000	4.1 million tons	-15.1%	14	9	-8.6%
1999	4.8 million tons	-1.2%	15	6	-7.2%
1998	4.8 million tons	19..9%	16	6.8	1.0%
1997	4.0 million tons	-41.5%	15	8.1	30.2%
1996	6.9 million tons	-12.8%	17	3.7	-41.2%

Source: Illinois Environmental Protection Agency Annual Landfill Capacity Reports

As of 2008, there were no landfills remaining in the city of Chicago – due to a moratorium on new landfill siting and a shortage of space. In 2007, the last remaining city-based landfill, the Waste Management Site at 134th and the Calumet River, closed. The most proximate landfill to Chicago, located in the western suburb of Hillside, also closed in 2007. Declining landfill capacity, coupled with opposition to new landfills, a decline in vacant space, and rapid growth in Chicago's collar counties, has led the region's waste to be transported to landfills farther and farther away and has increased waste disposal costs (Terese 2008). Much of Chicago's waste is currently hauled to Pontiac and Rockford, Illinois, both of which are approximately 80 to 120 miles outside the city.

Because of the lack of geographic proximity, waste in the Chicago region is often routed through an intermediary, or transfer station, where it is combined with trash from other trucks and hauled elsewhere by a larger semi-truck trailer to reduce costs. There are 72 active transfer stations in the Illinois EPA Region 2, of which 10 are C&D transfer stations. At last count, 16 of the transfer stations were located in the city of Chicago (EPA 2007), while transfer facilities in Melrose Park, Elk Grove Village, and East Chicago, Indiana handled most of the waste in Cook County. Some transfer stations also remove, sort, and clean materials that can be sent to recycling facilities.

Landfills are the last stop on the demand chain for surplus C&D materials given that they accept all waste. They do so for a price – the "tipping fee" – which, in 2006, ranged from $23 to $45.50 a ton in Illinois. These costs have increased by almost 40 percent since 1995 – due, in part, to restricted supply, reliance on decentralized transfer stations, and the rising cost of diesel fuel (Terese 2008), but they are still lower than in other parts of the country ($75 per ton in Portland).

As the disposal facilities of last resort, most landfills disregard the condition of the materials they accept. They have little incentive to sort or encourage reuse because they receive the bulk of their revenues from hauling and tipping fees. Allied and Waste Management are the largest hauling companies in the United States, they maintain a strong presence in Chicago, and they own and operate most of the transfer stations around the city. They are also themselves end-users of a by-product of the construction and demolition process: rubble, or what has come to be known in the industry as "Chicago dirt." Sanitary landfills are required to cover their refuse with dirt ("alternative daily cover" or ADC) every evening, and dirt mixed with C&D materials provides a better landfill cover than dirt as it is denser and has fewer voids through which odors and gasses can escape. Moreover, some unsorted C&D waste (particularly wood products) can be an input for another source of profit for landfills: recovering and selling methane as energy (Terese 2008).

On top of these disincentives for reuse, municipalities, landfills and hauling companies have anti-scavenging policies to explicitly discourage diversion of C&D materials from the waste stream. Whether they prohibit scavenging due to concerns for injury, legal liability or protecting profits, these policies are intended to deter individuals from removing recyclable materials from the waste stream before they reach their intended or contractual destination.

Recycling facilities

Approximately one-third of all commercial and residential C&D materials in Chicago are recycled (Worthington 2007). Other data from the City's C&D Diversion Ordinance – which covers larger residential and commercial projects – would suggest that the share recycled is much higher: closer to 85 percent of the weight of recyclable materials in 2007. If the heaviest building components – bricks, concrete and asphalt – are reclaimed and recycled, these relatively high figures may be accurate.

There are about 31 recycling and reclamation facilities for C&D materials located in the city of Chicago, with another 40 located in other municipalities in Cook County (City of Chicago Department of Environment 2006). Examples of established recycling, reclamation, and sorting facilities include those owned by national waste management companies such Premier and Allied (most of whom own their own disposal sites and haulers), as well as independents such as Recycling Services Inc., which recently built Chicago's only dedicated, permitted C&D Material Recovery Facility. These facilities accept C&D materials and perform at least one of the following three functions: (1) process C& D materials, either by converting the raw materials into secondary

commodities or by sorting and cleaning them; (2) sell the secondary commodities or sorted/cleaned primary commodities to a final or intermediate user; and (3) send the residual to a disposal facility.

Which factors determine whether C&D materials are sent to a recycling facility or a landfill? The ability to separate and segregate the material is one of the most important factors that determines whether they are disposed in a landfill or are sent to a recycling facility (Kluko 2006). In most cases there is a correlation between the strength of the market and the ease with which materials can be separated and removed from a structure without incurring damage to them. Linoleum and carpet tiles, for example, are nailed and glued together, are difficult to detach from each other, and have weak secondary markets. Recyclers either accept materials drop-offs or will pick up materials from job sites. They either accept only pre-sorted materials (e.g., bricks placed on pallets) or commingled loads. These facilities use a variety of more and less labor-intensive techniques including conveyor belts, hand sorters, shakers, and cranes with magnets to sort materials.

Pricing depends on the composition of the load and whether it has been pre-sorted. For example, most recycling facilities pay providers for bricks, scrap metal, and cardboard. In 2004 scrap metal prices soared to more than $300 per ton up from $77 a few years earlier (Byles 2005). In contrast, recycling facilities impose tipping fees to accept unsorted, mixed loads. Chicago area recyclers charge "gate rates" of between $40 to $50 per ton of mixed material.

Market price for the commodity is another important determinant. Typically, recycling facilities purchase higher-value materials that can be reprocessed and for which there are established secondary markets. These include concrete, brick, ferrous/non-ferrous metals, soil, glass, gravel, drywall, asphalt pavement, roof shingles, wood, appliances and fixtures. Waste wood is sent through a chipper and turned into mulch, concrete is crushed for fill, and scrap metal is shredded and melted down for resale to steel mills and foundries.

Some of the secondary markets for processed C&D materials are quite strong – notably the scrap metal market, for which demand outpaces supply as countries like China and India experience construction booms. Some types of wood and concrete a can also turn a profit. Concrete, for example, is reprocessed or crushed and used as road base replacing virgin limestone, engineered backfill for under foundations, back or trench fill for buried infrastructure as well as for sub base grades under parking lots. However, the markets for used drywall, glass, roofing, and flooring are substantially less developed.

The third factor is timing. Contractors will send their materials to recyclers when the hauling process is fast and streamlined. Contractors operate under compressed schedules; if sending their job site concrete to a grinding facility (where it can be crushed) involves no intermediary steps and allows them to profit quickly, such an option will look preferable to sending the same heavy, bulky materials to a landfill. Minimizing transportation costs requires haulers to reduce load volumes, weight, and trips. This occasionally motivates contractors to do their own recycling at the job site if they own or

lease the proper equipment – for example, renting a concrete crusher to make fill for other jobs.

The fourth factor is size. Larger jobs tend to be those that are commercial or industrial buildings composed of concrete, bricks and metal. These materials are readily recycled ---- mostly into fill or alternative daily cover. Smaller residential structures are composed of less fill-ready material and have more component parts that are potentially reusable.

The fifth factor influencing the recycling rate is the regulatory environment, which will be discussed in more depth in the final sections of this report. Some cities have passed ordinances that mandate job-site recycling or require that a certain share of C&D materials be recycled or reused.

The materials that recyclers cannot process and resell are sent to the landfill facilities in the region or are disposed of in some other fashion (melted, burned or buried). In some cases, materials are brought to specialized disposal facilities; for example, haulers transport carpeting to Newton County, Indiana, and dirt and concrete is often hauled to the Vulcan-owned facilities in Northern Illinois. Residual materials may be dropped off at the disposal site or picked up by haulers.

Reuse and salvage facilities

Reuse operations remove building materials and appliances from the fast-moving waste stream to resell them to property owners and contractors. In such cases, single-family homes and smaller structures generate more potentially reusable materials than commercial properties or large multi-family buildings. This market is segmented according to the quality, provenance, and value of those materials. At the top of the chain are salvagers who specialize in architectural and historical objects. These may include kitchen appliances, bathroom and lighting fixtures, tiles, flooring, doors, and staircases. A number of specialty salvagers, such as those sourcing antique barn wood, emerged during the last construction boom.

For-profit salvagers total approximately ten in the region, including the well-known Architectural Artifacts, Salvage One, and Urban Remains in the city of Chicago and Murco, which operates in the region. They source their materials from demolition and estate sales in Chicago (often in suburban locations) and across the country (occasionally from international locations, although transportation costs are making procurement from such places cost-prohibitive), or from dealers who act as middlemen. Most of these businesses are located on the fringe of high-income neighborhoods, where property owners with idiosyncratic tastes, historic homes, and interior designers are concentrated.

Other businesses sell those used building materials that may lack architectural or historic value but that are less expensive than if purchased new. These operations tend to be run by non-profit organizations that have experience with other kinds of resale and thrift stores (i.e., those that sell consumer appliances and clothing). There are only three reuse centers in the region, all of which are ReStores run by the non-profit Habitat for

Humanity. These ReStores are located in the western suburb of Elgin, southern suburb of Chicago Heights, as well as in the far northern municipality of Gurnee. They sell primarily good quality dimensional lumber of uniform dimensions, plywood, cabinets, doors, appliances, and fixtures.

We interviewed managers of reuse centers across the country. They report that their customer base is comprised primarily of those individuals who:

- want to upgrade their owner-occupied or investment properties
- own older properties
- want to avoid paying market rates for the materials (either because they are income-constrained or because they are opposed to the notion of paying full price)
- have the time, energy, and skills to work with less standardized materials
- are between 25 and 60 years old
- are recent immigrants

Despite the presence of this demographic in the Chicago region, only a small share of the total C&D waste stream – some observers estimated that it is far below 10 percent – is reused. Another estimate puts the deconstruction and re-use diversion rate at only .2 percent of the total waste stream (Guy, quoted in Miller 2008). Based on previous analyses of Chicago and other national studies, an estimated 60 to 70 percent of total C&D waste stream ends up in landfills, and 20-30 percent is either recycled on-site or at an off-site recycling facility (EPA 1998; Worthington 2007; Chini and Bruening 2003).
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IV. Potential Demand for a Reuse Facility in the City of Chicago

The fact that such a small amount of the Chicago region's surplus C&D materials is being reused implies that there is either little demand from end-users other than landfills and recycling facilities or, more likely, that demand for such materials is undeveloped and disconnected from sources of supply. The waste and construction specialists interviewed for this study overwhelmingly suggest the latter. In particular they identify the problem as one of market development and intermediation stemming from two main gaps. First, C&D materials need to be extracted from buildings in such a way that preserves their condition between job site and roll-off box and between roll-off box and processing. Second, sources of supply and demand must be brought together so that consumers can access materials and materials suppliers can access consumers.

Reuse stores typically fill both gaps. They require a reliable source of donations and methods to retrieve C&D materials from the waste stream before they get crushed or otherwise damaged. As such, the moment between when materials are collected and when they enter the roll-off box offers the critical and often compressed window of opportunity. Reuse stores insert themselves at this moment by reaching out to property owners engaged in building activities and offering deconstruction techniques as an alternative to demolition.

Deconstruction can be divided into two basic categories: structural (disassembling walls, roofs, joists, beams) and non-structural (removing fixtures, appliances, flooring and other items that are not part of the building's basic structure). Non-structural deconstruction is a more mature industry across the country than structural deconstruction, in part because it is "minimally affected by code issues, project time constraints, and local housing policies," as well as environmental concerns (HUD 2001). Those property owners interested in deconstruction may hire a specialized contractor, appraise the value of the building products, and donate the salvaged materials. Deconstruction contractors disassemble the materials, removing the roofing shingles from the sheeting or plywood, the tile and glues from the sub-flooring, and the nails from everything – the last of which is an especially expensive and time-consuming process. They segregate the painted from un-painted wood, saving the beams or door and window frames.

Many reuse stores across the country operate their own deconstruction businesses so that viable products can "soft land" as good-quality inventory and separate parts of this supply chain can be vertically integrated. In other instances, a conventional construction or demolition contractor may perform the work and will deliver less-damaged materials to the reuse store.

Reuse stores require a sufficient amount of space to clean and house the bulky inventory. Once at the facility, the staff processes the products so that they can be resold. This may involve removing nails from 2-by-4s or using solvents to remove resins from PVC pipe. Reuse centers we surveyed across the country rent or own space that ranges from 18,000 square feet (ReStore in Gurnee) to 35,000 square feet (Kansas City, Missouri ReStore 23,000 square foot of interior space plus a 12,000 square foot exterior space) to 64,000

square feet (The Rebuilding Center of Our United Villages in Portland, Oregon). In several instances, including the Kansas City ReStore, the municipal government sold or rented the land and/or buildings to the reuse facilities at below-market value.

The Kansas City ReStore is a case that we will describe in more detail in the latter portion of this report. In 2007, this ReStore handled inventory valued at approximately $1.7 million and made sales of approximately $1.6 million. This represents a more than 500 percent increase in sales from 2001, their first full year in business. In 2007, the bulk of their sales consisted of lumber (19% of total sales), followed by tile/brick (13%) and windows (13%), doors (11%) and cabinets (10%). They estimated that sales of these products diverted 2,609 tons of C&D materials out of the waste stream. Most of their materials were sourced from property owners and contractors who dropped off materials to their facility, while 36 percent were collected off-site and 11 percent came through their deconstruction service. However, the more valuable shipments were collected directly from the job site by ReStore staff. During 2007, the ReStore employed a staff of nine people, not including its deconstruction crew.

Would the city of Chicago be able to support a reuse operation similar in size and scope to the Kansas City ReStore? The Kansas City ReStore, the only one of its kind in its market area, serves a city of 447,306 and region with a population of approximately 2 million residents. The Chicago region is 5 times larger, and, although it hosts three ReStores in outer-ring suburbs, they are relatively small and local-serving. Such a difference in scale would suggest sufficient potential supply and demand to support a Chicago-based store. National observers point out that Chicago is one of the only major North American cities *not* to host a C&D reuse store.

To better assess the size and sources of potential demand, we created a profile of the typical consumer of used C&D materials and applied this information to the demographics and building attributes of Chicago neighborhoods. The critical drivers of reuse identified by our interview subjects translated into the following five indicators:

- Share foreign born population, 2000 (high, medium, low)
- Share of population that are homeowners, 2000 (high, medium, low)
- Share of housing stock built before 1959 (high, medium, low)
- Construction and renovation permits issued, 2007
- Share of households whose median income falls within the range between 20 percent above and below the city's or county's median income, 2000 ($38,600 for the city; $45,900 for the county) (high, medium, low)

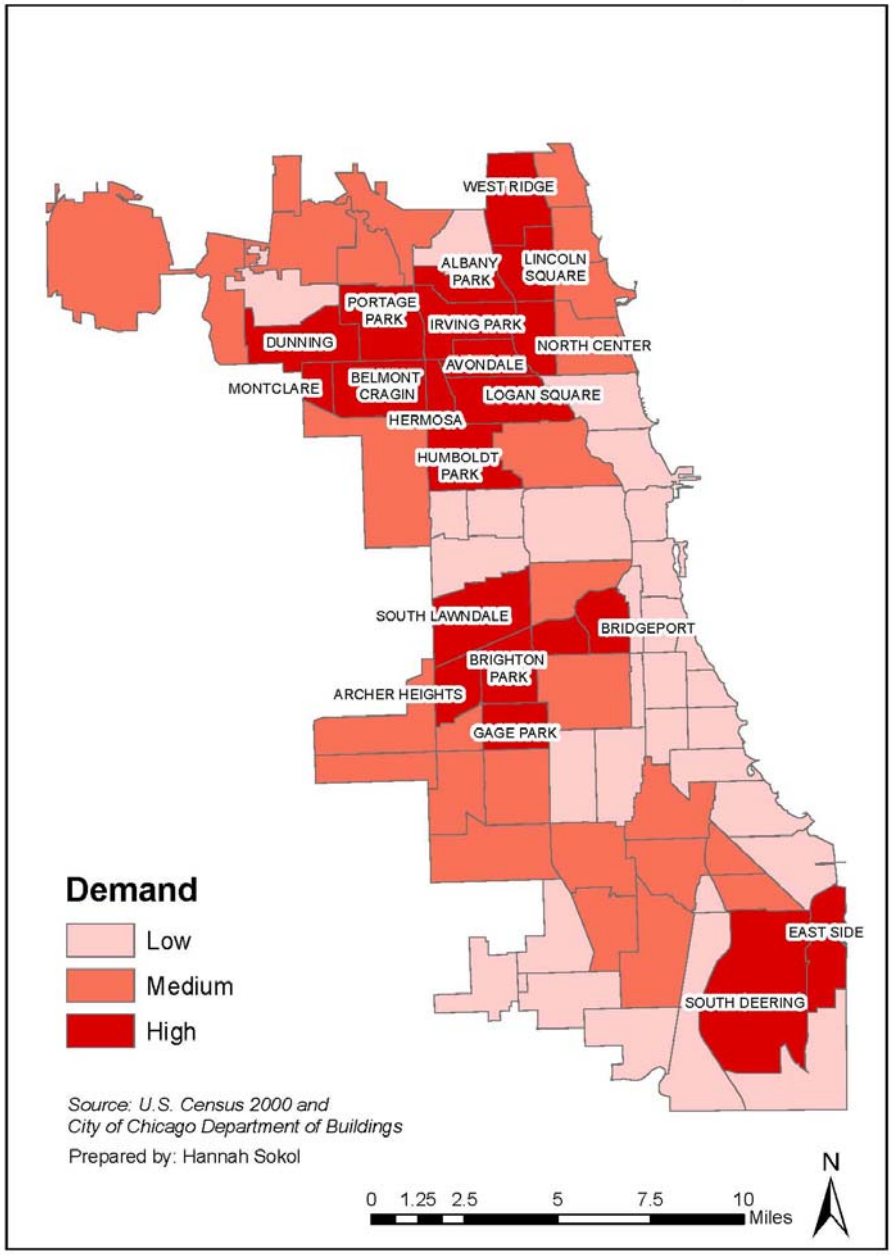
In other words, the strongest potential market for a reuse store lies in middle class, immigrant neighborhoods with an older housing stock and high levels of housing investment.

Data for each of the five indicators were obtained from the 2000 Census and from the City of Chicago Department of Buildings for each of Chicago's 77 community areas. The following 21 Chicago community areas were ranked high in the first four indicators and had median incomes that fell into the designated range:

Albany Park	East Side	McKinley Park
Archer Heights	Gage Park	Montclare
Avondale	Hermosa	North Center
Belmont Cragin	Humboldt Park	Portage Park
Bridgeport	Irving Park	South Deering
Brighton Park	Lincoln Square	South Lawndale
Dunning	Logan Square	West Ridge

Spatial analysis reveals that these neighborhoods cluster into three specific "hot spots" whose residents exhibit the strongest potential demand for used building materials: a west cluster, south-central cluster, and a south-east cluster (see Figure 6). The clusters tend to encompass older, residential neighborhoods that have experienced a round of new, mostly foreign-born in-migration. At the same time, these are not port-of-entry neighborhoods like Pilsen and Little Village, but ones where immigrant households move when they acquire savings and make the investment in homeownership. These clusters are characterized by small, brick bungalows with the occasional 3-flat and multi-family apartment building. They are adjacent to neighborhoods experiencing white, upper-income in-migration and property value appreciation (i.e., gentrification) but tend to be less proximate to the Central Business District.

Figure 6: Chicago Community Areas with High Potential Demand for Used Building Materials



To determine whether Chicago could support a reuse store, we assume that property owners of residential structures in these 21 neighborhoods would be the primary source of demand for used building materials. In 2007, new construction and renovation in these neighborhoods was valued at $350,111,276 based on our permit data. If even one percent of this investment was sourced from used materials (the standards for LEED buildings are anywhere from 5 to 10 percent reuse), sales receipts from a centrally-located reuse store would total $3.5 million. This amount is more than twice the $1.6 million in sales that the Kansas City ReStore needed to support a 35,000 square foot facility and nine employees in 2007.

In 2007, new construction and renovation in the hot-spot neighborhoods resulted in an additional 10,049,285 square feet, according to our permit data. Using the conversion algorithms discussed earlier, this is the equivalent of 87,850 tons of C&D materials in these neighborhoods that year. If contractors sourced even one percent of the volume of materials needed for these investments from a reuse store, it would create demand for 878 tons of product. For comparison's sake, the Kansas City ReStore estimates that it sold 2,609 tons of materials in 2007. Taken together, these calculations (the dollar amount of sales calculation higher, calculation by weight lower) suggest that demand currently exists to support a reuse store that is approximately the same size as the Kansas City ReStore (35,000 square feet) located in proximity to these three clusters -- assuming that consumers are made aware of the store and willing to travel out of their cluster to purchase these materials at reduced cost.

It should be noted that these estimates are likely to understate the actual value of building investment in the neighborhoods given that a significant portion of our permit data were missing occupancy codes (i.e., whether they were residential or commercial) and therefore were omitted from our calculations. Moreover anecdotal evidence suggests that demand for used building materials appears to be growing in spite or and because of the current economic crisis. For example, a building material reuse store in Springfield, Massachusetts reported that its sales were up by 10 percent in 2008, while similar stores in Asheville, North Carolina and Rochester, New York reported an increase of 15 and 18 percent respectively. When credit is tight, stronger pressure exists to minimize construction costs. Moreover the growing market for green products indicates a burgeoning environmental awareness that could increase future demand for used products, particularly in cities where materials costs tend to be higher. On the other hand, housing investment has been dropping steadily since 2005, and one cannot expect the number of permits in the near future to resemble the number pulled during 2007.

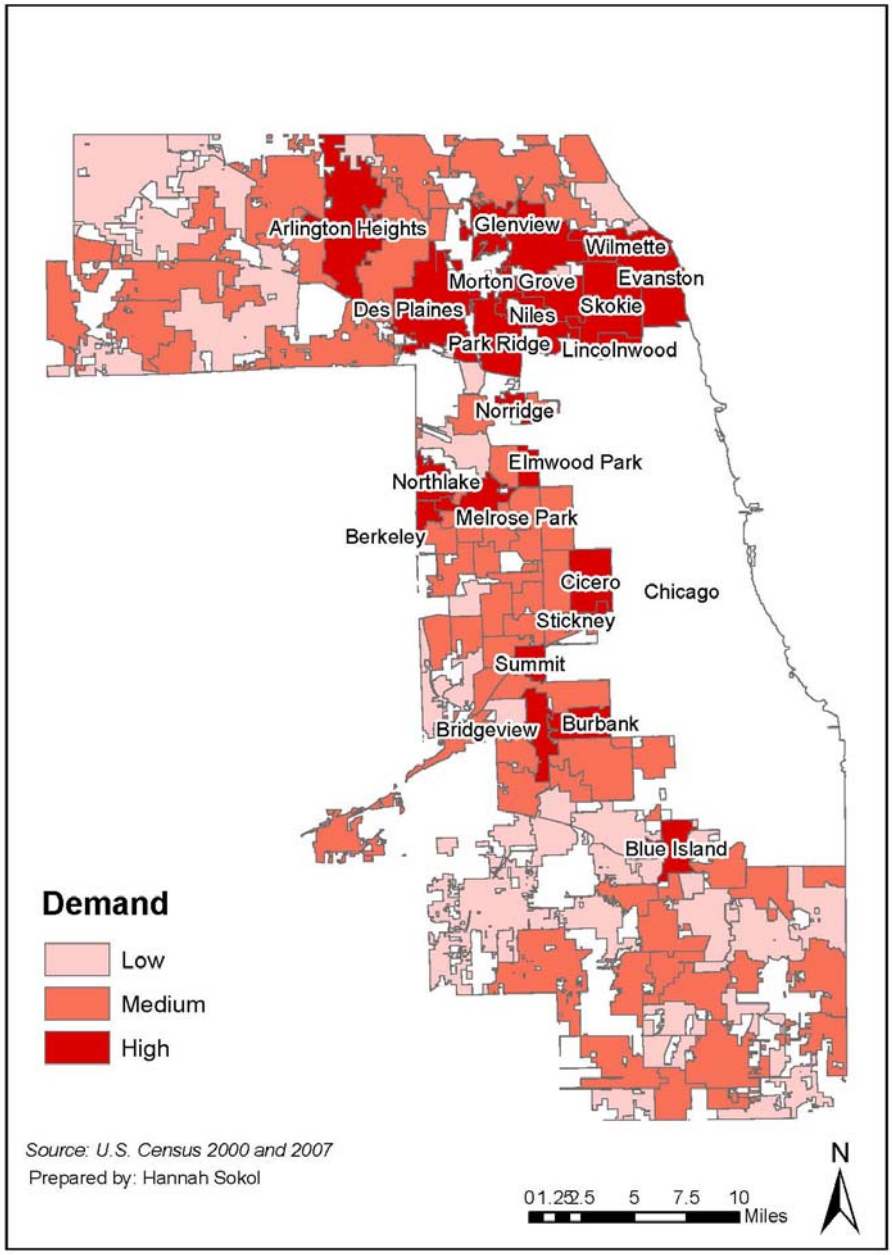
Applying the same methodology, approximately 20 Chicago suburbs were also identified as being hot spots of potential demand for used building materials. These include:

Arlington Heights	Elmwood Park	Norridge
Berkeley	Evanston	Northlake
Blue Island	Glenview	Park Ridge
Bridgeview	Lincolnwood	Skokie
Burbank	Melrose Park	Stickney
Cicero	Morton Grove	Summit
Des Plaines	Niles	Wilmette

As Figure 7 demonstrates, most of these municipalities are inner-ring suburbs and/or located in the north-west portion of the region. Property owners and contractors located in the inner ring suburbs such as Cicero and Burbank may be willing to travel the short distance to purchase materials from a reuse store on the south-west side. As such, a reuse store may want to consider locating along a trafficked east-west arterial (e.g., Roosevelt Road, Ogden Avenue) or expressway (Eisenhower, Stevenson) to readily access this suburban market area.

Our interview subjects infer that demand for used building materials is less of a problem than accessing supply to meet that demand. “Whatever we can get our hands on moves,” noted one manager of a ReStore, commenting on the store’s high turnover rates. Our estimates suggest that in order to generate the volume necessary to support a reuse store the size of the one in Kansas City, approximately 21 houses (at the suburban average of 2,262 square feet) would need to be fully deconstructed per year. This assumes that 111 pounds of C&D materials are generated per square foot of building area. Twenty-one houses is a small share (ten percent) of the total number of houses currently demolished in our sample of high-income suburban municipalities.

Figure 7: Suburban Municipalities with High Potential Demand for Used Building Materials



V. Market Barriers to Building Deconstruction and Material Reuse

Despite the strong potential for a reuse store, numerous hurdles to building deconstruction and material reuse currently exist, both generally and specifically in the Chicago region. The following discussion identifies and analyzes these market barriers.

Poor source separation practices at job sites: For most construction and renovation contractors, waste reduction is not a part of their core business model. They operate with low profit margins and under tight schedules. Separating potentially reusable materials from garbage adds extra time and expense that few are willing to invest.

Employment trends in residential construction and demolition: In order to deconstruct a sufficient number of buildings to build a reuse market, it is necessary to have a sufficiently-sized workforce that is trained to do deconstruction. This workforce still needs to be developed in the Chicago region given that deconstruction activity is in an early phase.

Moreover workers that are employed by conventional demolition contractors are becomingly increasingly deskilled (Doussard 2008). The industry is variable, contractors cannot promise steady employment or long-duration jobs, and labor must be flexible. Contractors subcontract out to trades people for the most skill-intensive work and to day laborers for that which is less so. Deskilling the construction and demolition process allows contractors to reallocate project costs away from expensive subs toward more substitutable, low-age workers that – given the increase in undocumented migration to the United States -- are in strong supply. Remodeling and demolition are some of the most labor-intensive forms of construction work, and the pressure to use less-skilled workers is more intense. Less-skilled workers are less likely to be concerned about the after-life of building materials.

Delays in permitting process: Currently, to undertake deconstruction in Chicago, one must be an approved demolition contractor and must apply for a demolition permit. The building permitting process is lengthy, onerous, and expensive. Delays cost developers money, and create an incentive to carry out demolition activities as quickly as possible. Some municipalities will not allow a building to be demolished until a building permit has been issued. These timing issues pose a barrier to deconstruction, which takes typically longer than demolition.

The cost of deconstruction: Although recent studies have shown that costs decrease as contractors move up the learning curve, deconstruction often takes longer and is more labor intensive than demolition. One study found that in Massachusetts, deconstruction costs were approximately 17-25 percent higher than demolition costs (Dantata et al 2005). Some of these costs are reduced by the tax deductions received from donating building materials. However buildings owned by non-profits, the public sector, or lower income households may not receive any preferential tax treatment in opting for deconstruction and materials donation.

Availability of landfill space: Although landfill space in limited in the Chicago region, it is relatively plentiful in Illinois, and the cost of landfilling in the region is relatively low. This calculus may be changing as waste must be hauled further from the city and the cost of transportation continues to rise due to increased fuel prices. Still, the availability of landfill space and low tipping fees are serious impediments. Contractors in other states have more incentive to explore alternatives to demolition and C&D landfilling because disposal space is more limited – notably the densely populated New England states.

Availability of recycling opportunities: If contractors are willing to sort and separate their surplus C&D materials, they are more likely to haul them to recycling facilities than to find opportunities to reuse them. Even though it is difficult and expensive to obtain a siting permit for C&D recycling from the state of Illinois for locations other than those in Cook and DuPage counties, recycling facilities in the area exist and have already reached out to contractors. They can offer an immediate pay-off in terms of fees or rebates for the tipping of pre-sorted materials. In contrast, contractors have few channels, other than informal, word-of-mouth connections, through which to provide building materials for reuse. They lack information about and few ways to reach potential consumers of these materials and so tend to discount their existence. There are few retail establishments in the City of Chicago offering these materials other than the handful of high-end architectural salvage stores.

Lack of standardized grading system for used lumber: Salvaged lumber and wood products are growing in popularity as older wood from old-growth forests is considered higher-quality than newer wood, and wood is generally becoming scarce. However, there is no standard grading system for used wood like the one that is used for virgin lumber. Building codes require that wood be graded properly for their intended use, and building inspectors look for this when they conduct an inspection at the framing process. An inspector's lack of knowledge about the quality of salvaged lumber may be a serious impediment to passing the inspection. Additionally, developers and contractors want assurance that a salvaged beam, for example, is strong enough to be reused for the same purpose in new construction or renovation. Thus, the lack of a standard grading system for used wood poses an obstacle to reuse.

Changes in materials usage: Wood products being used in construction and renovation projects are increasingly composite or engineered wood products, rather than solid wood, and these products cannot be reused and recycled within some established markets (Guy 2004). Making salvaged lumber more available for such projects would be an incentive in itself, as lumber from old-growth forests, which can be salvaged from older houses being taken down, is considered higher-quality and more valuable than either newer lumber or wood products made from composite materials.

Concern about materials contamination: Contractors and property owners express concern about the potential for salvaged materials to be contaminated with asbestos and lead paint. Materials that contain either may not be appropriate for reuse.

Asbestos: Asbestos is considered a hazardous air pollutant under EPA's "National Emission Standards for Hazardous Air Pollutants" (NESHAP) regulations. The Asbestos NESHAP addresses demolition and renovation and specifies that some asbestos-containing materials (ACM) do not have to be removed prior to demolition, except where demolition will be conducted using certain techniques. Several other categories of asbestos-containing materials must be removed before demolition begins. These requirements, however, do not apply to residential buildings with four or fewer units.

For deconstruction, it is advisable to remove all asbestos-containing materials since deconstruction poses a greater worker exposure than mechanical demolition (Molloy 2008). Any materials that contain asbestos are not viable for reuse. Therefore, in effect, all ACM must be abated prior to deconstruction regardless of whether it is considered regulated. (Molloy 2008) The removal of nonfriable asbestos (a type which does not crumble easily), which may be left in place in a standard demolition and debris disposal, can cause deconstruction to cost significantly more (Falk and Guy 2007). Building owners should remove any asbestos as part of the salvage or deconstruction agreement, and no deconstruction project should be started until the building has been inspected and any known asbestos remediated by trained, licensed professionals (Falk and Guy 2007).

Lead based paint (LBP): LBP was banned in 1978, but houses built before then may have LBP materials – especially walls, woodwork, siding, doors and windows. LBP can be hazardous when inhaled or ingested, especially for children.

In some contexts, disposal may be more costly and complex in a deconstruction scenario than in demolition. In Illinois, LBP waste removed from a household by the homeowner or a contractor can be disposed of as municipal waste. If construction or demolition debris containing LBP still adhered to the substrate is generated from a non-residential structure, it can be handled as municipal waste. But if the LBP is removed from the original substrate, the waste is considered "special waste", and must also be tested to determine if it is a hazardous waste, and the entire waste stream tested. Contractors must take precautions to prevent release of the lead into the environment. The handling and disposal of hazardous waste must be conducted in accordance with applicable Resource Conservation and Recovery Act regulations. If the contractor determines that the LBP waste is hazardous, then it must be treated prior to disposal in a facility that is permitted by the Illinois Environmental Protection Agency (IEPA) to accept that waste.

If the special waste is determined to not be a hazardous waste, the waste may be certified by the generator to be just solid waste provided it does not exhibit certain characteristics. The generator of the special waste may certify the waste if the waste passes the paint filter test (is not a liquid), does not contain PCBs, is not a hazardous waste, is not regulated asbestos-containing material, does not result from shredding recyclable metals, and is not former hazardous waste rendered non-hazardous (IEPA 2007).

In terms of reuse, there is currently no regulatory or policy guidance that either permits, prohibits, or qualifies practice for salvaging and reusing building materials coated with lead-based paint (LBP), particularly lumber and timber products (Napier et al. 2005).

While regulations and standards governing LBP in different contexts have been promulgated by several different federal agencies, they define LBP differently and for different purposes. Despite there being regulations from these different agencies, the applicability of the regulations in the context of recovering and reusing building materials is unclear or nonexistent – and this ambiguity often creates a disincentive to reusing high quality materials that are painted (Napier et al 2005). For example, due to the lack of guidance, agencies such as the U.S. Army are reluctant to remove LBP-coated materials from military installations and reuse them in local building projects.

Lack of awareness: Most contractors, developers, and home owners are not aware of deconstruction and of building material reuse as options in the Chicago region. Even for those who may have heard of deconstruction, few believe that it is a financially viable option. Additionally, consideration of deconstruction as an alternative to demolition must be planned well in advance and budgeted for by a developer.

Penchant for "the new": In American consumer culture "new" is generally associated with "better." A well-developed advertising industry and a retail industry dominated by a handful of home improvement chains ensure that contractors and home owners purchase new materials through channels that are familiar and easily accessible. A shift in such thinking appears to be occurring as the market sours and consumer expenditures decline. As such, building material reuse is likely to become more culturally acceptable in the near future.

VI. Best Practices for Building Deconstruction and Material Reuse

Best practices for encouraging building deconstruction and material reuse can be found at all levels of government and in nonprofit and private organizations throughout the country. These practices tend to be concentrated in the Northeast, where landfill space is rapidly diminishing and landfill disposal fees are high, and on the West Coast, where an established green ethos has made them more commonplace. Indeed, California is home to many of the country's deconstruction and reuse requirements and incentives.

The following examples are meant to illustrate the range of best practices—those identified by the literature or by interviewees as effective or innovative—rather than provide a comprehensive inventory. The examples in this section that promote deconstruction specifically (as opposed to diversion of materials) are identified with an asterisk.

Public Sector Requirements

Diversion requirements: The State of California, through the *California Waste Management Act of 1989*, requires that every city and county divert 50 percent of its waste materials. California law (Chapter 501, Statutes of 2002 (Kuehl, SB 1374)) directed the California Integrated Waste Management Board to develop a model C&D diversion ordinance which was made available to jurisdictions to help them develop ordinances that would meet their local needs. As of 2006, the city and county of San Francisco require that mixed C&D debris be transported off-site by a registered hauler and taken to a registered facility that can process a minimum of 65% of the material generated from construction, demolition or remodeling projects.

Closure of landfills to construction & demolition debris: The State of Massachusetts' *Beyond 2000 Solid Waste Master Plan* aimed to achieve 70 percent overall waste reduction. Effective 2006, the State prohibited certain C&D materials – specifically, asphalt pavement, brick, concrete, metal and wood – from disposal, transfer for disposal, or contracting for disposal at solid waste facilities.

Construction site recycling requirements: In Portland, Oregon when a building or demolition project is valued at $50,000 or more, the general contractor must ensure that specific materials produced on the job site are recycled. Where no general contractor has been named on the permit application, the property owner is considered the responsible party.

*Mandated salvage period: The town of Atherton, California requires that every structure planned for demolition "be made available for deconstruction, salvage and recovery prior to demolition. It shall be the responsibility of the owner, the general contractor and all subcontractors to recover the maximum feasible amount of salvageable designated recyclable and reusable materials prior to demolition" (Atherton Ordinance No. 506: An Ordinance of the Town of Atherton Adding a New Chapter 15.52 to the Atherton Municipal Code, Relating to Recycling and Diversion of Construction and Demolition

Debris). Similarly, the city of Cotati, California has required since 1993 that reusable and recyclable materials from all structures to be demolished be made available for salvage before demolition takes place.

Construction demolition debris deposit: The City of San Jose, California implemented a construction demolition debris deposit (CDDD) program whereby the city collects a deposit from every remodeler and contractor submitting an application for a building permit. When the city receives an application for a project permit, it assesses a deposit based on the square footage and type of project planned. The amount of the deposit is listed on the permit receipt given to the applicant. Prior to starting their demolition, construction or remodeling project, applicants are instructed to determine how they will manage their C&D debris and any excess building materials, taking three options into consideration: materials can be taken to a CDDD-Certified Facility for recovery/recycling; they can be reused or donated; or some materials taken to a CDDD-Certified Facility for recovery/recycling and other materials reused or donated. The deposit is returned if the applicant recycles/reuses their construction and demolition debris and submits the appropriate documentation. Deposits that are not claimed are used for such purposes as construction of green municipal projects.

*"Green Building" requirements: Boulder, Colorado's Green Building requirements mandate that an applicant for a building permit for a new dwelling or an addition to a dwelling demonstrate that at least 50 percent of construction waste will be recycled. Additionally, an applicant proposing to demolish more than 50 percent of exterior walls must demonstrate through a "deconstruction plan" that at least 65 percent of material by weight from the deconstruction of the existing structure, including concrete and asphalt, will be diverted from landfills. These requirements apply to residential new construction, demolition, remodeling and additions, including without limitation single-unit dwellings, multi-unit dwellings, and dwellings within mixed-use developments.

The city also requires that applicants for building permits obtain a minimum number of "Green Points" based on the type and square footage of the building. Up to five points can be earned for reusing the existing building (saving 50 percent of exterior walls earns 3 points, while saving 75 percent of exterior walls earns five points). Up to three points can be earned for achieving waste diversion beyond the mandatory requirements by using the city's Deconstruction Plan and Construction Waste Recycling Form or an inventory of material proposed to be diverted by a qualified deconstruction contractor to create a site-specific deconstruction plan. (A copy of the form is included in this report as Appendix C) And up to three points can be earned for diverting new construction waste.

*Waste Management Plans: Santa Monica, California's *Construction and Demolition Waste Recycling Ordinance* establishes requirements for reduction of solid waste from construction-related activities. It requires that contractors develop a Waste Management Plan for activities that require a construction or demolition permit. In preparing the Waste Management Plan, applicants for demolition permits involving the removal of all or part of an existing structure must consider deconstruction to the maximum extent feasible, and

must make the materials generated through deconstruction available for salvage prior to landfilling.

Moreover, the city's municipal code requires recycling of C&D waste in construction contracts and preparation of a demolition and site protection plan. It recommends (but does not require) salvage of reusable materials and separation of recyclables from demolition.

*Building for disassembly: The City of Santa Monica's *Green Building Ordinance* applies to new construction and encourages developers to design buildings so that materials can be easily disassembled, reused and recycled. The ordinance states: "The city encourages developers to, in commercial applications, consider demountable partition systems that can be moved as interior uses change in commercial applications; specify fixtures and equipment that can be repaired or salvaged to minimize waste; consider in design how repairs or removal will occur, and allow access for these purposes; specify materials and methods with high potential for recyclability, wherever possible avoiding composite products that make separation difficult or impossible; and, to ease future disassembly, use bolt and nut fasteners before screws; screws before nails; nails before strippable adhesives, and strippable adhesives before permanent glues such as contact cement or epoxy."

*Deconstruction requirements for HOPE VI projects: The Hartford Housing Authority (HHA) in Connecticut was the first housing authority in the country to require a deconstruction program for all redevelopments funded under the HOPE VI program, a program of the U.S. Department of Housing and Urban Development (HUD) that provides funds for communities to replace distressed public housing projects with mixed-income housing. In 1998, HUD began to allow HOPE VI grant recipients to use demolition funds for deconstruction projects. In 1998, with the anticipated deconstruction of public housing units at Stowe Village, CT, HHA released a Request for Qualifications to identify developers who would integrate deconstruction training, work with a deconstruction service company made up of residents of public housing, and continue to work with this company after the initial pilot project period was over. The result was the incorporation of a construction company that employed residents of Stowe Village to carry out deconstruction that was formed in a venture between the HHA and a private development company.

*Demolition deterrents: Several communities in the Chicago area – including Evanston, Winnetka, and Highland Park – have imposed a "demolition tax" or fee for teardowns (Kuczka 2009). It is unclear whether deconstructing a home allows the homeowner to avoid this fee. Revenue from the tax is being used to fund towns' affordable housing initiatives or to help towns recoup costs they incur due to teardowns.

Public Incentives

*Expedited deconstruction permitting: The town of Los Altos Hills, California recently eased the permitting process for deconstruction projects. When a deconstruction contract is attached to the permit application, permit fees are waived. Moreover the new building plans move to the front of the approval queue.

Recycling Market Development Zones: This California Integrated Waste Management Board program combines recycling with economic development to help develop new businesses, expand existing ones, and create jobs. The state provides loans, technical assistance and free product marketing to businesses that use materials from the waste stream to manufacture their products and that are located in a zone. Assistance is provided by local zone administrators and the board's referral team. Local government incentives may include relaxed building codes and zoning laws, streamlined local permit processes, reduced taxes and licensing, and increased and consistent secondary material feedstock supply. Free product marketing is provided through the RecycleStore, which showcases innovative recycled-content products and puts buyers in touch with the manufacturers. While this program focuses on recycling, it could also be applied to reuse.

Public Education and Technical Assistance

*Information provision: King County, Washington (in which Seattle is located) provides extensive information and assistance aimed at increasing diversion rates for construction, demolition and deconstruction projects. The County provides "jobsite waste guidelines, a waste management plan template, sample waste recycling specifications, directory of local construction waste recyclers and more. Available assistance includes presentations to jobsite workers on building material reuse, salvage, and recycling, site visits to assess diversion options and research on recycling options for hard to recycle commodities."

The North Carolina Department of Environment and Natural Resources Division of Pollution Prevention and Environmental Assistance maintains a website that includes a comprehensive, searchable recycling markets directory, and **"**NC Waste Trader**,"** a statewide "waste exchange service" for discarded or surplus materials and products designed "to divert recoverable materials from disposal while providing feed stocks and supplies to potential users."

Guidebooks for architects and contractors: The publication "Recycling Construction and Demolition Wastes: A Guide for Architects and Contractors," published in April 2005, was sponsored by the Boston Society of Architects, Associated General Contractors of Massachusetts, and the Massachusetts Department of Environmental Protection, with support from several additional organizations. It offers a valuable multidisciplinary perspective on these issues to agents responsible for reuse decisions.

*Deconstruction demonstration projects: The Austin, Texas City Coliseum Deconstruction project, undertaken in 2002, involved the deconstruction and demolition of the City Coliseum and various other smaller surrounding buildings. The contractor was directed by the city to optimize the amount of material being diverted from this project. The project was publicized on the city's website, and public salvage sales took place afterwards. The city's website noted, "Although the salvage industry is established in Austin, the network of information available to the public is still emerging. It is the goal of the City of Austin, through projects like the City Coliseum Deconstruction, to widen the public's awareness of the salvage market and construction waste management practices."

*Public funding for reuse centers: The City of Los Angeles successfully applied to the California Integrated Waste Management Board for a $50,000 Reuse Assistance Grant that allowed them to partner with the ReUse People to develop a reuse facility for construction and demolition materials in the city. Funds will be used to encourage deconstruction practices in the city.

Non-profit and Private Sector Incentives

*Training for deconstruction: The Youth Employment Partnership (YEP), which operates employment programs for low-income youth, worked with Beyond Waste Inc. to deconstruct a portion of the U.S. Navy's former Fleet Industrial Supply Center, now owned by the Port of Oakland. The project, carried out in 1996-97, yielded a recovery rate of 70% of materials, as well as wood chipped for mulch and fuel. YEP and a partner planned to deconstruct six additional buildings on the site, involving training 75 youth and 38 adults (including many women) in construction trade skills (Leroux and Seldman, 1999/2000).

*Green building ratings systems: Green building programs such as the LEED (Leadership in Energy and Environmental Design) system developed by the U.S. Green Building Council and the Green Globes program developed by the non-profit Green Building Initiative provide an important incentive for green building activities – including deconstruction, salvage and reuse – because an increasing number of developers want to market properties as sustainable and energy efficient. Additionally, government agencies are increasingly requiring or providing valuable incentives for buildings that are certified under these programs.

LEED is by far the dominant green building rating system. The growing popularity of LEED building certification is leading to an overall increase in awareness of green building techniques. LEED awards points for deconstruction- and reuse-related activities in new building and renovation including building reuse, diversion of 50 or 75% of materials, 5 or 10% reuse of materials, and use of materials or products extracted, harvested or recovered regionally. The LEED standard for homes includes points for construction waste management planning, diversion of construction waste reduction, and use of reclaimed materials and items like doors, counters and cabinets.

Particularly strong are the program's construction waste management sections, which require consideration of options for diverting waste, and the building reuse sections. Additionally, the points offered by LEED for Homes for reclaimed building components appear to be a direct nod to the possibility of reusing materials yielded from building deconstruction. And the regional materials portion of the LEED standards for new construction and major renovations could serve as an incentive for using materials recovered from deconstructed buildings.

Green Globes, a green building rating system and suite of tools places a relatively strong emphasis on deconstruction and material reuse. For new construction, there are seven areas of assessment; factors included in the "materials" area include reuse of existing buildings; durability, adaptability and disassembly; demolition waste (reduce, reuse, recycle); and recycling and composting facilities.

Additionally, the National Association of Home Builders has developed the very progressive "National Green Building Program," which includes both model green home building guidelines and a Green Scoring Tool that offers points leading to three possible levels of certification. Among the activities for which points can be earned are: using advanced framing techniques that reduce the amount of building material while maintaining the structural integrity of the home; using pre-cut or pre-assembled building systems or methods; disassembling existing buildings (deconstruction) instead of demolishing; reusing salvaged materials where possible; dedicating and providing on-site bins and/or space to facilitate the sorting and reuse of scrap building materials; developing and implementing a C&D waste management plan that is posted at the job site; conducting onsite recycling efforts; and using a life-cycle assessment tool to compare the environmental burden of building materials and, based on the analysis, using the most environmentally preferable product for that building component.

Non-Profit Education and Technical Assistance

*WasteCap Wisconsin: WasteCap Wisconsin (there are also WasteCaps in several other states) is a statewide, nonprofit, industry-supported organization that provides waste reduction and recycling assistance to businesses. Funding sources include membership, sponsorship, and grants. The organization evolved out of the Wisconsin Department of Natural Resources (DNR), where an employee was assigned to assist the business community with reuse and recycling. However, businesses preferred to work with a non-government entity. The DNR applied for and received a grant to create WasteCap Wisconsin in 1998.

WasteCap Wisconsin provides an entire range of C&D-related services, including drafting C&D waste reuse and recycling specifications and management plans; providing technical assistance, market information, and research support; instructing contractor/subcontractor employees about their role in the program; conducting waste audits; monitoring the program; ensuring proper placement, timing, and labeling of trash and recycling dumpsters; documenting construction waste management results; and calculating the financial impact of the program's implementation. Private contractors

often request WasteCap's assistance in providing construction waste management services. And due to WasteCap's training program to teach demolition and deconstruction contractors to do recycling and reuse, there are now over 250 accredited professionals in construction and demolition recycling.

WasteCap provides information to property owners, including an online, searchable directory of haulers, processors and recyclers for C&D waste (www.wastecapdirect.org). The organization also matches suppliers of materials with organizations interested in buying or accepting them. For example, as part of a demolition process that preceded construction of a new arts district in Madison, WasteCap helped connect building owners and contractors with nonprofit organizations that took over 1,000 items for reuse. Two reuse days were organized, during which participating organizations marked items they wished to reuse, and subsequently collected these items.

Other major providers of education and technical assistance are the Building Materials Reuse Association and the Deconstruction Institute.

*Non-profit directories: Numerous national organizations publish national directories of recycling/reuse resources, including the Construction Materials Recycling Association's directory of C&D recyclers and the Building Materials Reuse Association's directory of businesses and contractors in the deconstruction and reuse industry. Additionally, a group of federal agencies, private sector companies, non-profit organizations and educational institutions publishes the Whole Building Design Guide, which includes a searchable construction waste management database created by the U.S. General Services Administration. And numerous states provide waste exchange websites and services.

*Reuse centers and stores: Reuse centers that serve as national models for best practices do more than sell building materials for reuse. They often have their own deconstruction operations – or partner with an organization that does – and may include job training. They may convert salvaged building materials into furniture and other items that are then sold by the center. Some centers offer classes focusing on sustainable building design. Others work to serve as models of sustainability themselves, making their buildings and operations as energy-efficient and low-impact as possible.

A recent study published by the Center for ReSource Conservation, "Best Practices: Building Material Reuse Industry," examines logistical issues ranging from staffing practices to facility atmosphere. The study can be found at: http://www.resourceyard.org/assets/docs/BestPracticesBuildingMaterialsReuseIndustryFinalv2.pdf. Two of the reuse centers that serve as national models for best practices are described below.

Habitat for Humanity Restore, Kansas City, Missouri: The store, part of the large national network of ReStores, opened in 2000. The deconstruction portion of the operation began in 2002. The store is located in a highly industrial part of town by the river. It is not a walk-by location. However, it is close to the highway, and the building is large and ideal for this kind of operation. The building is owned by the city, which rents to the store at a below-market price. The ReStore fits with the city's development goals for the area,

which include other recycling and facilities. The state of Missouri is divided into solid waste management districts, each of which offers some grant money for programs to encourage waste diversion. The store has received grant money through this program and through the state Department of Natural Resources. This has allowed the business to grow – for example, the ReStore recently built a lumber barn in which to store lumber.

The ReStore partners with The ReUse People on deconstruction projects including one to train demolition contractors to perform deconstruction. They have made connections through organizations like the National Association of Remodelers and National Association of Home Builders. Many of their clients are developers and builders who regularly demolish multiple houses. These connections lead to a diversity of inventory. Customers are especially interested in kitchen cabinets, plumbing fixtures (toilets, sinks, bathtubs, etc.), ceramic tile, and lumber. They also sell large quantities of paint, which they price low. The ReStore encourages green design and serves as a model itself. They have a 400,000-square-foot rain garden, sell rain barrels, give classes on making rain barrels, and have an extensive recycling program.

The Rebuilding Center of Our United Villages, Portland, Oregon: The ReBuilding Center, a project of the non-profit organization Our United Villages, opened in 1998 and moved to a 24,000-square-foot warehouse in 1999. In 2005, the center added 40,000 square feet of developed property. The store is located in a large warehouse in a location that is convenient to customers and in a neighborhood that could benefit from the center's job opportunities.

The customer base is broad, ranging from someone seeking a $5 door to someone seeking a $500 door. Customers come from all over Portland regardless of income level, as Portland residents are extremely environmentally minded. Customers include many do-it-yourselfers, and are generally people who care about the environment and are willing to take the time required to search through items in the store. Donors of building materials from deconstructed houses range across the economic spectrum, but tend to be higher-income.

In addition to retail sales, the Rebuilding Center offers deconstruction services; gives popular classes on topics such as "Instrument Making From Recycled Materials" and "Plumbing Workshops: Install a Toilet"; operates ReFind Furniture: Sustainable Designs Using Reclaimed Materials, where salvaged materials are made into furniture and other higher-priced items (these items are displayed in a "showroom" within the main store); hosts classes to assist students to transform discarded building materials into new items; and engages in community outreach activities that support the mission of Our United Villages.

Additionally, the Rebuilding Center regrades salvaged lumber. This is done by an employee trained and qualified by West Coast Lumber Graders to carry out this function. The Rebuilding Center also has its own grade stamp, which allows it to grade only used lumber and only on its own premises. According to a Rebuilding Center manager, carrying out this service does not result in any additional cost for the store as the

employee who regrades lumber is a regular store employee who does so as one additional line item on his job description. The store pays a monthly fee to West Coast Lumber Graders in order to maintain its qualification to regrade. The manager noted that the store's sales of regraded lumber offset the cost of the monthly fee, as well as adding value and education. He also stated that they receive positive feedback from building inspectors, who appreciate the effort to reduce waste.

Regarding concerns about contamination, it is important to note that some reuse centers *do* sell painted materials. For example, the Rebuilding Center of Our United Villages sells painted wood materials, but only if the paint is not flaking, chipping, or otherwise coming loose from the piece. A store manager conducts "paint condition" training with employees to enable them to identify which painted wood pieces can and cannot be sold. In order to provide a warning about the possible presence of LBP and information about how to protect oneself from LBP, the center puts lead warning stickers that include EPA contact information on all painted pieces, and posts signage about LBP in the store. A Rebuilding Center manager noted that customers "really appreciate the education," which they can apply not only to items purchased at the store, but also more generally to LBP that may exist in the pre-1978 homes of many of the store's customers.

VII. Policy Incentives for Increasing Building Deconstruction and Material Reuse

Policy and programmatic reforms can help the market to overcome the barriers we discussed previously. Any policy requirement or incentive that is established must be bolstered with a strong foundation of public, private and nonprofit sector education, outreach, and technical assistance. Once a government agency takes a step to require or encourage deconstruction and reuse, those affected will immediately seek out practical, nuts-and-bolts information about how to conduct these processes. Thus, this informational infrastructure must support the shift from demolition and disposal to deconstruction, reuse, and a green economy.

This section of the report is divided into two parts: suggested policy reforms specific to the Chicago region and those that are more generally applicable. In our conclusion, we suggest initial steps that can get building deconstruction and material reuse activity off the ground in Chicago.

Regional policy context

The City of Chicago and State of Illinois currently have promulgated several requirements and programs that encourage building deconstruction and material reuse. These include:

- The Environmental Action Agenda, issued by the City in 2006, identifies goals for recycling of construction waste: 25 percent in 2010 and 50 percent in 2020;

- The Chicago Climate Action Plan, issued by the City in 2008, notes that a 90 percent reduction in waste trucked to landfills by 2020 could net about a .84 million metric tons drop in emissions, and that actions to reduce, reuse and recycle must increase. Chicago's overall goal is to reach an 80 percent reduction in greenhouse gas emissions from 1990 levels by 2050, with the sharpest reductions occurring by 2020.

- The City of Chicago Construction and Demolition Diversion Ordinance requires diversion of 50 percent of construction and demolition debris from qualifying projects. It includes helpful information such as a publication on best management practices, "Chicago's Guide to Construction & Demolition Cleanliness & Recycling" and a listing of recyclers.

- The City of Chicago's Green Permit Program, administered by the Department of Construction and Permits, which offers expedited permitting (and waiver of consultant code review fees in some cases) for projects that incorporate innovative green building strategies. Commercial projects must earn various levels of certification within the appropriate LEED rating system; smaller residential projects must meet or exceed US EPA's EnergyStar requirements. In addition, many projects must apply certain strategies or technologies selected from a list of menu items that

enhance sustainability, expand affordability, stimulate economic development, and increase accessibility. Menu items pertaining to sustainability include water management, natural ventilation, green roofs, and renewable energy. While developers could undertake salvage/reuse as a component of achieving LEED certification, these activities are not specifically addressed.

- The Chicago Department of Planning and Development's Sustainable Development Policy "applies to all new Redevelopment Agreements, Planned Developments, Site Plan Approvals and Amendments to existing Planned Developments reviewed by the Department of Planning and Development's weekly Design Review Committee after December 1, 2007" and requires that specific types and sizes of projects meet green requirements that include LEED certification and green roofs. While reuse could be undertaken as a component of achieving LEED certification, salvage and reuse are not specifically included in the policy.

- The Chicago Standard, a set of construction standards for City of Chicago public buildings that consists of 46 practices and technologies from the LEED rating system. The "Materials & Resources" category offers points for building reuse, use of regional materials, and resource reuse. LEED offers incentives for reuse, but has the potential to be strengthened in these areas.

- The State of Illinois provides information and incentives related to C&D recycling and reuse. For example, the Illinois Sustainable Technology Center provides a guide entitled, "Illinois Construction and Demolition Debris Reuse/Recycling Options and Contacts," and can help builders find viable sources for recycling construction waste, establish job-site recycling programs, and identify waste recycling firms that offer unique construction contracts. The Illinois Housing Development Authority's pilot green building program for mixed-income housing offers points for reuse of materials as part of the "green points" that can be earned in order to receive scoring points under the state's Low-Income Housing Tax Credit Qualified Allocation Plan.

Suggestions for Reform

Based on best practices for deconstruction and building material reuse discussed in the previous section, our literature review, and interviews with policymakers, practitioners, and other experts, we have identified the following policy requirements, incentives, and education, training and technical assistance activities that could increase deconstruction and building material reuse and make these activities a priority green building issue in the Chicago region.

Public requirements

Expand the scope of the City of Chicago's Construction and Demolition (C&D) Diversion Ordinance: The City of Chicago's construction and demolition ordinance, passed by the City Council in 2005, states that projects subject to this law "shall be required to recycle or reuse construction or demolition debris produced on site as part of

construction or demolition activities" – 25 percent for projects issued permits in 2006 and 50 percent for projects issued permits in 2007 and after. This ordinance represents an important step in the right direction. However, it does not prioritize reuse over recycling; in other words, it does not require that a proportion of materials be reused if feasible or that the possibility of reuse be considered. Moreover the ordinance does not require a Waste Management Plan, as many other similar ordinances do. Such plans require developers to research and consider methods of diverting materials beyond recycling, including reuse. Most importantly, the ordinance does not apply to construction or demolition of smaller buildings or single-family houses. The ordinance does apply to all renovation projects that require a certificate of occupancy from the Department of Buildings but these are limited to construction of new residential buildings with four or more units; construction of new non-residential buildings of more than 4,000 square feet; demolition of residential buildings with four or more units that includes demolition of at least one outside wall; and demolition of non-residential buildings of more than 4,000 square feet.

In order to strengthen this ordinance, we suggest that it be modified to:

- Require a Waste Management Plan that would indicate the estimated volume or weight of the project C&D material, by material type, to be generated; the maximum volume or weight of such materials that can feasibly be diverted via reuse or recycling; material proposed to be salvaged, reused, or recycled during the course of the project; the facility which the applicant proposes to use to collect or receive the materials; and the estimated volume or weight of C&D materials that will be landfilled.

- Include smaller buildings and single-family homes.

- Include separate lines for amount of C&D recycled and amount of C&D reused on the required recycling compliance forms. Currently, only one line is provided, for a combined recycled/reused total.

Reform permitting process to require consideration of deconstruction over demolition: The City and other municipalities should require that deconstruction be considered in conjunction with or as a replacement for demolition as a condition for issuing a demolition permit. The City could provide information about deconstruction to demolition permit applicants. The City may also want to extend the waiting period before buildings can be demolished during which time the structure could be made available to properly trained and insured deconstruction personnel to salvage as many materials as possible before the eventual demolition.

Mandate deconstruction training for demolition contractors: The City of Chicago or the State of Illinois could mandate that all demolition companies attend deconstruction seminars prior to the issuance of demolition permits. Contractors could be required to attend continuing education courses - including those that pertain to deconstruction – in order to maintain their licenses.

Build reuse requirements into publicly subsidized redevelopment programs: The City of Chicago does not mandate pre-demolition salvage, deconstruction, or reuse in the RFPs that govern the disposition of public land or in publicly funded projects. As part of the RFP process, Chicago and other municipalities can require materials recovery or reuse, require a salvage period, and/or offer additional points in the bidding process for deconstruction and high material recovery rates. For subsidized projects like HOPE VI or those using Tax Increment Financing, the City can require pre-demolition salvage or deconstruction of housing units being taken down. The Department of Planning and Development could require developers of redevelopment projects to review building components in structures scheduled for demolition to assess their reuse potential.

Limit amount of C&D debris in landfills: The Illinois EPA should consider restricting the amount of construction and demolition materials that can be deposited in landfills. This agency could require that landfills charge fees based on volume rather than weight or load of waste materials. Since C&D materials such as lumber tend to be higher in volume than weight, this would serve as an incentive to divert C&D materials. The Illinois Department of Revenue may also want to consider applying the sales tax to tipping fees.

Public Incentives

Offer deconstruction permit: The City could offer a "Dedicated Deconstruction Permitting" that allows for the additional time that deconstruction requires and reduces fees relative to those charged for demolition permits. Permit fees could be calibrated to the amount of materials recovered.

Offer points under Green Permitting/Green Building programs for deconstruction and reuse. All of these very influential programs mentioned above could add points specifically for deconstruction, diversion for reuse, and reuse of building materials. For example, the Green Permit Program, which offers incentives considered very valuable to developers, could award extra points for these particular activities. The Sustainable Development Policy could require one or more activities related to deconstruction or reuse, much in the same way that it currently requires a green roof for certain projects.

Support reuse centers by providing grants, low-interest loans, publicity, tax incentives, and other assistance: The City and State can support reuse centers by providing below-market rents on publicly owned warehouse space or selling public space to reuse stores for below-market value. These entities could also publicize the work of reuse centers (for example, distributing information about them at mortgage closings). The State could also reduce sales taxes for purchases of used building materials.

State or federal tax credits could be offered for donation of building materials resulting from deconstruction in order to address the lack of a financial incentive for tax-exempt building owners – who are not eligible for the tax deduction for donated materials – to deconstruct their buildings. Secondary markets for tax credits exist so that recipients who do not pay income taxes, such as non-profits, can sell them to investors who could benefit

from the credit. As an example, a Chicago company that manufactures rooftop solar systems has set up a process for transferring tax credits for tax-exempt buyers of solar systems to investors who can make use of the credit.

Support deconstruction training: In order to establish deconstruction as a regular practice, it is necessary to have a large enough workforce that is trained to do deconstruction. The City should fund training programs designed specifically to build deconstruction assessment and planning skills. Such programs could be included in the Green Jobs Initiative that is part of the City's Climate Action Plan.

Incorporate deconstruction and reuse into affordable housing programs: Currently, deconstruction and reuse are not integrated into affordable housing programs in Chicago and Illinois in a consistent fashion. Designing for the use of used building materials in large mixed-income housing complexes can be difficult as there is a need for uniform doors, windows and similar items. However, salvaged lumber and brick could potentially be used even in larger buildings.

The Illinois Housing Development Authority's (IHDA) Green Housing Initiatives Program includes a portion on reuse. Under the program, projects must earn a certain number of "green points" in order to receive either one, two or three tax credit points under the state's Low-Income Housing Tax Credit Qualified Allocation Plan. The program is currently in a pilot phase. Components of the program that offer incentives for reuse include use of recycled/recovered content underlayment; recycled/recovered content gypsum wallboard; recycled/recovered content siding; reused wood flooring from reused, recovered or re-milled sources; cabinet fronts – reclaimed or re-milled; and outdoor materials – minimum recycled content material. The program could be strengthened by adding reused materials in addition to engineered wood alternatives for lumber for roof framing and floor framing, and other engineered alternatives for lumber; shelving and countertops – recycled particleboard/ MDF/ agricultural waste; and reconstituted and/or recycled content interior doors. Following the lead of the U.S. Green Building Council, IHDA could serve an important function in connecting green builders with reuse stores and deconstruction contractors. For the sake of clarity and consistency, it may be helpful for state and local policymakers to focus on one green building standard for affordable housing rather than the several that currently exist.

Public Education, Training and Technical Assistance

Carry out high-profile public deconstruction demonstration project: The City or State could publicize the project widely (city website, outreach to newspapers, TV and other media); invite residents to observe the process and to purchase salvaged materials; and provide written information describing the process and resources.

Provide or support training, education and outreach about building deconstruction and material reuse: Chicago and other municipalities could make information about deconstruction readily available and distribute it to anyone applying for a permit, especially demolition permits. They could also help to link those applying for demolition

permits to deconstruction companies. The City or State could provide education and outreach to architects, who are increasingly referring their clients to deconstruction service organizations; developers, who are also increasingly requesting the services of deconstruction service organizations; professional organizations (American Institute of Architects and others); and trade associations (contractors, homebuilders, carpenters, etc.). It could provide up-to-date information about end markets, including directories and materials exchanges in a multi-disciplinary handbook. If the public sector did not wish to take on the task itself, it could support an intermediary organization that would work directly with contractors. WasteCap Wisconsin, described in the previous section, is a model for this kind of assistance. The Illinois Sustainable Technology Center at the University of Illinois at Urbana-Champaign already performs a number of these functions; perhaps its role could be expanded.

Draft model C&D diversion ordinance: The State of Illinois could draft a model construction and demolition diversion ordinance for jurisdictions to use in creating their own ordinances.

Inventory abandoned buildings to assess deconstruction potential: The City can assess abandoned buildings and those scheduled for demolition to identify good candidates for deconstruction projects. They can make this database of information available to the public.

Support statewide recycling and reuse associations: The State could work with state and city recycling and reuse associations to increase awareness of deconstruction techniques. Sponsoring conferences and Internet web sites that advertise the organizations and businesses involved in building material recovery and reuse would be helpful.

Additional Policy Recommendations

Develop re-grading system for salvaged lumber: Researchers at the USDA Forest Products Laboratory are developing a grade stamp that could be used for reclaimed materials to show the material's grade and thus its acceptable use under a municipal building code. The first step in the re-grading process is to identify the local grading agency; these agencies are based on region and must be accredited by the Board of Review of the American Lumber Standards Committee (Kibert and Languell 2000). The Forest Stewardship Council's labeling system indicates that lumber is from a sustainably managed forest. This system could potentially include salvaged lumber.

Provide guidance on contamination issues: Asbestos: Various incentives noted in this report could help to equalize the additional time and expense of abating asbestos as part of deconstruction. For example, if the City's permitting process were allow for the additional time that deconstruction requires, contractors would have additional time for asbestos abatement. Similarly, a reduced or waived permitting fee for deconstruction could also ease the burden of additional asbestos work. Additionally, for all demolition and deconstruction projects, a municipality could require the complete removal of hazardous materials, and separate bids for this expensive work, in order to level the playing field (Leroux and Seldman 1999/2000).

Lead Paint: It would be helpful for federal agencies to either modify existing regulations or develop new regulations that provide standards and/or guidance for reuse of materials that contain lead-based paint. This would address the disincentive that the current ambiguity creates to reusing high-quality materials that are painted. The EPA, in collaboration with other regulatory agencies, could "provide clear guidance on appropriate methods and practices for salvaging and reusing LBP-coated building materials, specifically LBP-coated lumber and timber materials" (Napier et al 2005). In particular, these agencies could:

- Establish reasonable requirements for warning labels or markings that follow a consistent format and are based on realistic scenarios of reuse. For example, does the reuse of a painted wood stud as wall framing (normally enclosed within the wall cavity) require the same level of concern as a salvaged window painted with LBP?
- Consider and address issues of legal responsibility regarding the reuse of underlying wood materials once the LBP coating has been removed through remanufacture. Clarify the chain-of-custody responsibility for future removal, salvage, reuse or demolition.
- Quantify the acceptable lead content of materials reprocessed from LBP-coated wood materials. Distinguish between the amount of lead allowable on the material's surface (similar to a coating or film) and in the body of the material.
- Develop guidance and regulation for lead exposure, thresholds and content for materials being removed, the process of removal, materials intended for remanufacture and reuse, and materials considered hazardous waste.
- Establish Best Management Practices for removing LBP-containing materials from a structure, handling materials, removing paint or conducting other reprocessing or remanufacture activities, transferring materials from one party to another, and reusing the materials, either with or without paint coating.

(Napier et al. 2005).

For the local context, it would also be useful for the Illinois EPA to address the reuse issue in its guidance documents on handling, disposal and recycling of LBP waste and LBP-contaminated materials. It would be helpful for the regional office of U.S. EPA to provide guidance on contamination issues relevant to local conditions.

Integrate deconstruction and reuse into brownfield redevelopment: Applications for grants under the U.S. EPA's Brownfields Assessment, Brownfields Cleanup and Brownfields Cleanup Revolving Loan Fund grant programs can earn points in the grant review process for "Sustainable Reuse of Brownfields," which include the following activities: "prevent pollution and reduce resource consumption through, e.g., brownfields prevention, infrastructure reuse, native landscaping, innovative stormwater management/reuse, construction debris/fill reuse." The EPA should consider specifically including deconstruction and building material reuse – excluding contaminated materials.

Additionally, U.S. EPA has been using case studies to show how deconstruction can help brownfield developers recoup some of the costs of remediating a brownfield and enhance the financial viability of the process. It may be helpful for the regional office of EPA as well as other agencies such as HUD to develop and publicize case studies, *pro formas* and other such information focusing on projects conducted in the region.

Incorporate incentives into federal redevelopment programs: Federal redevelopment programs, such as HOPE VI, the Home Investment Partnership Program, Empowerment Zones, and Enterprise Communities, could use a bonus point system to create incentives for non-profit and local government agencies that incorporate deconstruction-related activities or building material reuse into proposals. Information about deconstruction and reuse could be integrated into HUD's "PATH Guide to Green Building". The PATH (Partnership for Advancing Technology in Housing) program provides tools and information for integrating advanced building technologies into housing projects.

Upgrade U.S. Green Building Council's LEED rating system: As discussed in the "Best Practices" section, the LEED rating system is an extremely important incentive for green building practices, including deconstruction and reuse. The standards will likely evolve to put an even greater emphasis on reuse. The standards could be further strengthened by prioritizing reuse over recycling, rather than offering points for the more generic "diversion." It could offer more points for reuse – LEED-NC, for example, offers just one point for reusing building materials. Moreover, the reuse section of the LEED standards for new construction and major renovations could be strengthened to include a percentage of reused materials above the current 5 to 10 percent. Additionally, the USGBC can be an important partner in providing information and resources on reuse.

Develop educational programs about the value of reuse: Professional associations and universities should develop programs to teach the importance of and techniques of "designing for deconstruction" or "designing for disassembly." This could include those in architecture, engineering, industrial design, interior design and public policy, among other academic areas. It is also important to make use of education to begin to change people's mindsets about reuse at an early age. Designing and carrying out programs for a wide range of audiences, from schoolchildren to professionals, can increase understanding about the importance of reuse and of consuming and diverting materials responsibly (Jacoby 2001).

Encourage design-for-disassembly and modular construction: According to Boston Consulting Group (2008), modular construction can reduce waste by 25 percent or more. In modular (or "prefabricated") construction, building components are assembled off-site, with potential to reduce waste in the construction process due to building to standard sizes, increasing recycling and reuse, reducing packaging and designing for deconstruction.

VIII. Conclusion

The market for used building materials in the Chicago region exists but, at present, is undeveloped. Institutional gaps on the supply and demand side hinder both the ability of C&D materials to maintain their condition for resale and the ability of contractors to sell these surplus products to final users. In particular the region lacks deconstruction specialists who could take buildings apart while preserving materials and construction contractors who have integrated waste management into their operations. It also lacks a sufficient number of reuse businesses that specialize, not in architectural treasures, but in good-quality building materials that can be sold at low prices.

Our analysis reveals that sufficient demand and supply currently exists to support a 35,000 square foot reuse store conveniently located along a major arterial or expressway in one of the three clusters of Chicago hot spot neighborhoods. Salvaged materials from deconstruction projects in the city and suburbs should be able to reach the reuse center within an hour, and the store may want to consider investing in or renting trucks that can pick up materials from donations sites. Partnering with some of the home improvement stores and independent haulers in the region may also increase the shipment of good-quality products and "seconds" to the reuse center. Partnering with non-profit home improvement organizations, such as Neighborhood Housing Services, and with professional associations of developers, builders, and contractors, such as the Chicago Rehab Network, can help shore up the demand side. Marketing the store to migrant-based community organizations and to new homeowners in the hot spot neighborhoods will also increase demand.

We also anticipate that demand for such a facility will increase over time as several trends play themselves out. A growing ecological awareness is influencing consumption patterns. Building owners are becoming more concerned about the waste they are generating through construction and demolition processes and may choose deconstruction over demolition and used materials over new ones. Moreover buying used has the potential save not only consumers money but also building owners and developers who will likely have to pay higher fees for dumping debris in landfill in the near future. This is why building material reuse stores across the country are reporting increased sales despite the current recession. Moreover, on the labor market side, deconstruction is becoming an oft-mentioned "green job" that has the potential to replace some of the manufacturing jobs that have been lost, while offering a path to additional opportunities in the construction industry and the skilled trades. If these building and labor market trends continue, it is likely that a larger reuse center or additional ones could be supported in the region.

There is always the risk, however, that the market will not develop to its full potential on its own. As such, the reuse store will need the support of local governments in terms of policies and programs that encourage and promote deconstruction and reuse. In the long term, a combination of public requirements, incentives, education, information, and

technical assistance can establish building deconstruction and building material reuse activity and helping to develop a market.

In the short term, the most effective ways to establish these activities quickly in the Chicago region would be for the City of Chicago and other municipal governments to offer a new deconstruction permit that is provided more quickly and less expensively (or, ideally, free of charge) than a demolition permit. When a deconstruction permit is issued, municipalities will want to ensure that the building was in fact deconstructed rather than demolished. The municipality could 1) require that a deconstruction contract be attached to the permit application, or 2) when the deconstruction work is complete but before a building permit is issued, it could require written validation that C&D materials were reused. We would also suggest that the City of Chicago add deconstruction and reuse to its Green Permit Program's menu of sustainable investments.

These two incentives should be supported with extensive information and resources about deconstruction and reuse. In this area, cost- and time-effective actions for the City of Chicago to undertake include:

1. Carrying out a public deconstruction demonstration project that is widely publicized, includes a strong educational component, and invites the public to observe the actual process and purchase salvaged items;
2. Unveiling a new website that contains comprehensive, nuts-and-bolts information and resources about how to carry out deconstruction and reuse; and
3. Incorporating a strong deconstruction and reuse element into plans for Chicago's Olympic bid. For example, the City could announce that all temporary buildings to be constructed for the Olympics will be deconstructed and the materials either donated for reuse or reused in municipal building projects, and that at least one new permanent building for the Olympics will be designed for future disassembly.

This combination of high-profile projects, valuable incentives, and practical information would catalyze deconstruction and reuse activity in Chicago.

In addition to actions that could be undertaken by Chicago and other municipalities, the State of Illinois could play an important part in helping to establish deconstruction and reuse statewide by providing financial or other assistance for developing educational resources, offering job training on deconstruction, and supporting workshops for developers, contractors, and design professionals. The State also plays a critical regulatory role in legislating C&D materials out of the waste stream. Limiting the amount of such materials that can be disposed of in landfills would provide both a strong message and a financial incentive for contractors to explore reuse options. Moreover, the federal government is also likely to play an important role in the near future. Funding programs for "green job" creation appear to be increasing, with President-elect Obama stating that development of a green economy will be a cornerstone of the imminent economic stimulus plan. Channeling these monies toward deconstruction training and reuse accomplish both economic and ecological goals.

All policies and programs should be evaluated before and after they are implemented to ensure that the economic and environmental benefits outweigh any administrative expenses. For example, the City of Chicago could track the number of projects applying for a Green Permit that included deconstruction and reuse. Using accepted algorithms, they could easily convert the square footage of the project into a volume of materials that have been diverted from landfills.

Many of the incentives for deconstruction and reuse we have suggested are relatively costless modifications of existing policies and programs and require little more than some up-front investment in time. Others – such as restricting C&D materials from landfills – would be more politically involved and labor intensive. Regardless, it is clear that the public sector plays an important role in steering the market in a direction that breaks the cycle of over-consumption and waste.

Appendix A

Technical Appendix

Methodology

For this study the approach for estimating the volume of residential C&D debris produced in Chicago and select Cook County municipalities was, in its basic structure:

[Activity level of construction, renovation, and demolition converted into square feet]
X
[Per square foot debris generation rate per activity][1]

In calculating C&D produced in Chicago, permit data was provided by the City of Chicago's Department of Buildings and for Cook County municipalities, U.S. Census Building Permit data for 2007 was used. Demolition counts were provided for 8 (Evanston, Glencoe, Golf, Kenilworth, Northfield, Oak Park, Wilmette, and Winnetka) out of the 14 municipalities while the remaining 6 demolition counts were calculated using an average demolition rate (demolitions/ total housing units).

Cleaning the Data

Because a number of Building and Renovation records omitted square footage data, average square footage and square footage-to-declared value ratios were substituted as follows:

For single-family construction and renovation records with omitted square footage data, the average square footage of remaining records was calculated after omitting outliers greater than 10,000 square feet. The average was then substituted for those records without square footage data.

The greater variation in the size of multi-family construction and renovation permit records made substituting an average square footage for omitted data unreliable. For multi-family records with square footage, the ratio of square footage-to-declared value was estimated and the median ratio was applied to declared values to calculate square footage where missing. Large records of over 1 million square feet were omitted both to ensure conservative estimates with uncertain data and because this would not reflect the near future yields.

Because demolition permits omitted square footage data as well as occupancy code classifications, the following assumptions were used to conservatively approximate the proportion of demolitions that were residential and the size in square feet of the

[1] Conversion algorithms from EPA 1998. Similar waste calculations have been performed by Cochran et al. 2006 and by Wang et al. 2004

demolitions undertaken. Using the Greater Chicago Housing and Community Development website's database the proportion of residential, single and multi-family, residential demolition permits for the year 2004 was examined and applied to the total number of demolition permits for 2007. The numbers of single-family demolition permits and multi-family demolition permits were multiplied by EPA provided estimates of typical size (square footage) of homes demolished. Homes demolished are on average older and so smaller than average home size today. Single-family homes were estimated at 1,600 square feet, multi-family homes at 1,000 per unit and 2 units per multi-family demolition permit. Total square footage was multiplied by the respective single and multi-family demolition debris generation rates provided by the EPA.

Limitations

As stated earlier, nearly 45% of renovation permit records omitted occupancy codes, and so the total yield of residential C&D debris may be an underestimate. However, EPA provided algorithms are largely based on suburban or small city point source observations and so could over estimate the total debris yield for Chicago. Demolition data provided lacked square footage and occupancy code data which may mean that the total yield of residential C&D debris is over- or under-estimated. In addition un-permitted renovation and demolition activity cannot accurately be quantified. Taken together, however, these issues may cancel each other out.

Appendix B

List of Interviewees

Two directors of the Building Materials Reuse Association

Four employees of the U.S. Environmental Protection Agency

Employee of the City of Chicago Department of Environment

Employee of the City of Chicago Department of Planning and Development

Two employees of the Illinois Environmental Protection Agency

Three general contractors working in Chicago area

Chicago-based affordable housing developer

Chris Bekemeier and Shane Endicott, The ReBuilding Center of Our United Villages, Portland, Oregon

Ken Barnes, Illinois Sustainable Technology Center

Dave Hampton, Echo Studio and Urban Habitat Chicago

Milan Kluko, Fountainhead Engineering

Jenna Kunde, WasteCap Wisconsin

Shoshanna Lenski, Boston Consulting Group

Don Reck and Brian Alferman, Kansas City ReStore

Ted Reiff and Ken Ortiz, The ReUse People

Jodi Murphy, Murco

Doug Widener, U.S. Green Building Council – Chicago Chapter

Appendix C

Sample Deconstruction Plan

Attachment C

Permit number:_____

City of Boulder
Deconstruction Plan and Construction Waste Recycling Form

READ PROGRAM GUIDELINES FOR SPECIFIC REQUIREMENTS
(Mandatory and/or point options for Green Points new residential construction, and remodels and addition projects greater than 500 sq. ft.)

PURPOSE: City of Boulder and Boulder County have robust waste diversion goals, working toward establishing a Zero Waste Community. The goal is to recover building materials first for reuse, second for recycling and then landfilling - only when no other alternative exists.

STEPS TO COMPLY:

For DECONSTRUCTION MANAGEMENT REQUIREMENTS – *MUST BE DONE BEFOE DEMO PERMIT SUBMITAL*

1. Contact one of the two non-profit organizations (identified below) for a deconstruction evaluation preformed by a Deconstruction Professional (DP) identifying a *material inventory* of what and how much of the building's materials, equipment and interior finishes can be donated for a tax deduction.
2. Complete and attach a copy of this form and a *material inventory* of the materials to be donated, and ensure the submitted form is signed-off by the DP.
3. Once this form and the *material inventory* are completed and sign-off on estimating 65% or more of the waste will be diverted, a deconstruction/demolition permit can be applied for. This form and an inventory need to be submitted with the deconstruction/demolition permit and/or building permit documents.
4. A completed Deconstruction Material Report or Construction Waste Recycling Tracking Spreadsheet (that include Hauler receipts, weight tickets and facility sign-offs or invoices are required as verification of the material diverted) must be submitted to Planning & Development Services (P&DS) to verify compliance or placed in the building permit sleeve before final inspection.

For NEW CONSTRUCTION WASTE RECYCLING REQUIREMENTS

1. Estimate what materials will be reused and/or recycled from you building site. Recycling ALL clean wood, cardboard and metal will count for 50% waste diversion. Points can be chosen for recycling above the required amount. Review Green Points Program Guidelines Booklet for additional point options.
2. Project quantities of waste generation can be calculated by sq. ft. It is estimated that 4 lbs. (per sq. ft.) of waste is generated by new home construction.
3. A Construction Waste Recycling Tracking Spreadsheet (that include Hauler receipts, weight tickets and facility sign-offs or invoices are required as verification of the material diverted) must be placed in building permit sleeve before final inspection.

Non-profit organizations providing Deconstruction Professionals able to perform Deconstruction Evaluations:
1. ReSource, Shaun LaBarre, 303-419-5427
2. The ReUse People, Kurt Buss, 720-226-5646

Applicant's Name:	**Phone:**
Property Address:	**Zip:**

Attachment C

Permit number:_____

Type of Dwelling (pick one) – Required

☐ Single-unit Dwelling ☐ Multi-unit Dwelling ☐ Townhome _____# of Dwelling Units

Accessory Structure ☐ Detached ☐ Attached

_____Existing Sq. Ft._____ Sq. Ft. to be deconstructed = _____ Remaining Sq. Ft. of existing structure

Describe structure to be deconstructed:

PROJECT DESCRIPTION: Please list all exterior alterations proposed for the property below. Additional resources can be downloaded at www.bouldergreenpoints.com can assist with estimations and/or diversion and waste generation quantities. All four pages must be included in the application.

REQUIRED

Project Address:	Date:
Permit Number:	Age of house (year built):
General Contractor:	Phone:
Property Owner:	Phone:
Existing Structure Deconstruction (sq. ft) ☐ Less than 50% of exterior wall area_____ *(DOES NOT HAVE DECONSTRUCTION REQUIREMENTS)* ☐ More than 50% of exterior wall area_____ ☐ Scrape-off _____	Project & Size (sq. ft) ☐ New construction_____ ☐ Interior remodel_____ ☐ Addition_____
Deconstruction Professional (preformed the deconstruction eval):	Company Name:
Deconstruction Professional sign-off:	Date:

Who are you intend to hire to deconstruct and/or the manager the job site construction waste recycling?

Deconstruction/RecyclingContractor: _____Company name:_____

Address:_____Phone:_____

Email:_____

Attachment C

Permit number:_____

Complete the Diversion Rate (DR) Table on the following page indicating the building materials that you plan to reuse, donate or recycle from this construction project. **Verification of the actual diversion will be tracked on the Construction Waste Recycling Tracking Spreadsheet available for download from the city's Web sites. www.bouldergreenpoints.com or www.boulderplandevelop.net**

Instructions for completing the Diversion Rate table by weight.

Column 1 - This is the **total** tons of materials generated from this project listed by material type.

Column 2 - Total tons of material type that was separated out for salvage or reuse onsite or taken to a building material reuse facility.

Column 3 - Total tons of material type that is taken to a recycling facility to be reprocessed into new products.

Column 4 - Total tons of material type that is taken to a facility that processes mixed deconstruction debris. Materials taken to a Boulder/Denver Registered Facility will be credited with 65% diversion. Registered facilities are approved by the city of Boulder, Office of Environmental Affairs.

Column 5 - Total tons of material type that is taken to a disposal/trash facility/landfill.

Column 6 - Name the hauler, contractor, and facility you are working with to divert the material. For contractor information refer to the "Construction & Deconstruction Waste, Reuse& Recycling Guide".

Attachment C

Calculate your **Diversion Rate** using the following formula

Permit number: _____

Material Type (Tons)	1. Total Tons Generated	2. Salvage or Reuse	3. Recycling	4. Mixed Processing Facility	5. Disposal/ Trash	6. Hauler, Contractor or Facility
Example: Lumber	*3*	*2.5*	*.5*			*2. ReSource /3. Western Disposal*
MANDATORY 65% DIVESION FROM EXISTING STRUCTURES TRIGGERING DECONSTRUCTION - EARN POINTS FOR HIGHER DIVERSION – REFERENCE THE GUIDELINE BOOKLET FOR MORE DETAILS						
Lumber						
Plywood						
Trusses						
Clean wood						
All Metal HVAC system /Appliances						
Working Appliances						
Doors/Windows						
Cabinets/Fixtures						
Wood Flooring/Tile						
Carpet/Pad						
Brick/Stone/Block						
Concrete/Rubber/ Plaster						
All Electrical Wire						
Subtotal						
TOTAL	A	B	C	D		
NEW CONSTRUCTION WASTE RECYCING – 50% MANDATORY DIVERSION – EARN ADDITIONAL POINTS FOR HIGHER DIVERSION – REFERENCE THE GUIDELINE BOOKLET FOR MORE DETAILS						
Clean wood waste						
Cardboard						
Metal						
Masonry						
Subtotal						
TOTAL	A	B	C	D		

B		C		D x ___ (DR)*			Divide by	A			x 100 =	Your Diversion Rate
	+		+		=				=			

Attachment C

Permit number:_____

[* If you are taking materials to Boulder/Denver Registered Facilities, using a Deconstruction Professional, or self-hauls (pursuant to Ordinance No. 7565) calculate D x .65 (65% minimum diversion rate (DR) requirement for deconstruction and 50% for new construction).

List all registered transporters that will be moving material off site.

Name: _____ Phone Number:_____
Signature:_____ Date: _____

Name: _____ Phone Number:_____
Signature:_____ Date: _____

Name: _____ Phone Number: _____
Signature:_____ Date: _____

I AGREE TO SUBMIT A FINAL REPORT for this Deconstruction Permit WITHIN 30 DAY AFTER COMPLETION OF THE DECONSTRUCTION PROJECT; FINAL REPORT MUST VERIFY THE ACTUAL DIVERSION ACHIEVED & **INCLUDE ALL RECEIPTS and WEIGHT TICKETS FROM FACILITIES.**
ESTIMATED DATE OF COMPLETION: _____

Submitted by (signature): _____ **Date** _____

Print Name _____ **Title** _____

If Your Diversion Rate is less than 65% for deconstruction or 50% for new construction waste, provide justification why the project cannot meet the 65% diversion requirement.

_____

_____

FOR OFFICIAL PERMITTING OFFICE USE ONLY

DATE PLAN/REPORT/TRACKING SPREADSHEET RECEIVED BY PERMITING OFFICE:

APPROVED _____ NOT APPROVED _____ DATE _____

COMMENTS _____

_____

APPROVED BY TITLE

_____

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