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The Economics of Residential Building Deconstruction in Portland, OR

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Cover photo: Lovett Deconstruction

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The Portland Bureau of Planning and Sustainability (BPS) develops creative and practical solutions to enhance Portland's livability, preserve distinctive places and plan for a resilient future. BPS collaborates with community partners to provide land use, neighborhood, historic, and environmental planning and design. The Bureau provides research, policy and technical services to advance green building, energy efficiency, waste prevention, composting, recycling, and a sustainable food system in Portland.

NERC is based at Portland State University in the College of Urban and Public Affairs. The Center focuses on economic research that supports public-policy decision-making, and relates to issues important to Oregon and the Portland Metropolitan Area. NERC serves the public, nonprofit, and private sector community with high quality, unbiased, and credible economic analysis. Dr. Tom Potiowsky is the Director of NERC, and also serves as the Chair of the Department of Economics at Portland State University. Dr. Jenny H. Liu is NERC's Assistant Director and Assistant Professor in the Toulan School of Urban Studies and Planning. This report was researched and written by Mike Paruszkiewicz and Jenny Liu. Research support was provided by Rebecca Hanes, Eric Hoffman, Peter Hulseman, and Emma Willngham.

The Institute for Sustainable Solutions (ISS) is a hub for sustainability at Portland State, supporting interdisciplinary research, curriculum development, student leadership, and meaningful community partnerships that contribute to a just, prosperous, and vibrant future for our region and the world.

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Photo: Lovett Deconstruction

EXECUTIVE SUMMARY

Housing in the Portland metropolitan area has achieved national notoriety in recent years. Rapid in-migration, housing price spikes, geographic constraints, and regional economic changes have meant development challenges throughout the metro area. An increasing trend in residential demolitions is among the most visible, with annual numbers far outpacing a previous peak during the 2006-07 housing boom. To address the growing sustainability concerns surrounding demolitions, the City of Portland's Bureau of Planning and Sustainability drafted a resolution that will require all homes built prior to 1917 or designated as historic to be deconstructed, rather than demolished, if removed, beginning in October 2016. In anticipation of this requirement, BPS asked the Northwest Economic Research Center (NERC) to examine the economics of deconstruction in Portland in late 2015. This report takes two approaches to the task. The first is a detailed analysis of the costs and benefits of deconstruction relative to conventional demolition. The second scales those metrics to estimate the overall effects that the requirement will have on the local economy, using IMPLAN, an industry-standard economic impact model.

Narrowly speaking, a full-house deconstruction is more expensive than a comparably-sized demolition. Table E1 compares the up-front costs of both removal methods, which diverge by more than 80% on average after accounting for the additional cost of foundation removal remaining after a deconstruction.

Table E1 – Single family residence gross demolition and deconstruction costs in Portland, OR

	Demolition	**Deconstruction**
Typical project time	2 business days	10-15 business days
Typical crew size	2 – 3	6 – 8
Estimated total labor hours	32 - 48	480 - 960[1]
Estimated gross cost of structure removal (1400 sf home)	$10,300	$14,000
Estimated cost per square foot	$7.40	$10
Estimated additional cost of foundation removal	$0	$4,800
Total gross costs	**$10,300**	**$18,800**

However, much of a demolition's cost is not captured by its price tag, and is instead borne by parties uninvolved in a given construction project. Construction and demolition (C&D) waste constitutes roughly one fifth of area landfills, and an average-sized demolition (1400 square feet, according to local data) produces roughly 42 tons of debris. Hazardous pollutants such as asbestos, lead, and other particulates can be released on a demolition site as a structure is pulverized and churned by heavy machinery, or at a later stage as contaminated material is inadvertently mixed with other debris. And less visibly, a great deal of avoidable resource and energy consumption is spurred when reusable building materials are crushed and buried. A wider cost-benefit analysis thus recognizes that these external costs are largely mitigated by deconstruction's relatively methodical disassembly and salvage of a home's constituent parts. In addition, deconstruction provides substantial benefits to property owners in the form of highly valuable salvaged material from a home, which can be sold or donated for a tax deduction that offsets the project's higher cost. According to local appraisal data, the contents of many deconstructed properties are worth tens of thousands of dollars.

At scale, the deconstruction requirement would apply to roughly one third of recently demolished properties in Portland. If 130 additional properties are deconstructed each year rather than demolished, the net impact on the local economy would be small, but positive. Depending on the average salvage value embodied in the deconstructed homes, the measure would result in 30 to 50 additional jobs and between one and one and a half million dollars in economic activity[2] (Table E2)

[1] At least one DAG member advised that the upper bound of this estimate exceeded a local deconstruction provider's records by up to 200 hours.
[2] Measured as "value added", the local equivalent to Gross Domestic Product.

Table E2– Economic impacts of Portland's deconstruction requirement

	Impact Type	Employment	Labor Income	Value Added[3]
Scenario A	Direct Effect	***	***	***
	Indirect Effect	-0.1	-$9,672	-$13,885
	Induced Effect	1.2	$56,040	$93,291
	Total Indirect + Induced	1	$46,368	$79,406
	Total Effects[4]	**30-40**	**$1,000,000-$1,100,000**	**$1,100,000 – 1,200,000**
Scenario B	Direct Effect	***	***	***
	Indirect Effect	-0.1	-$9,672	-$13,885
	Induced Effect	3.5	$168,226	$283,478
	Total Indirect + Induced	3.4	$158,555	$269,593
	Total Effects[13]	**40-50**	**$1,200,000-$1,300,000**	**$1,500,000-$1,600,000**

The benefits that Portland reaps from a move towards deconstruction and away from demolition depend on successful development of the local deconstruction industry and salvage markets, and the longer-term adoption of building methods that are compatible with deconstruction and reuse. Complementary efforts to support these developments will insure the return on Portland resident's collective investment in deconstruction.

[3] Value Added equals the sum of workers and firm proprietors income. It can be viewed as Gross Regional Product, the regional expression for Gross Domestic Product (GDP)

[4] Ranges reported for confidentiality reasons

Photo: Lovett Deconstruction

INTRODUCTION

Since the depths of the Great Recession, the economic recovery has brought a flurry of changes to Portland's built environment. Renewed employment and population growth have been accompanied by rising incomes, rapid redevelopment, and visible changes to the city's neighborhoods. As the city navigates these changes, there is growing attention on the intertwined issues of residential demolitions and the city's commitment to socioeconomic and environmental sustainability. There were 323 single-family demolition permits issued in Portland in 2015 - up from 308 the previous year – reflecting both high demand for larger homes in the inner city and increasing multifamily development. The situation has drawn neighborhood controversy, media scrutiny, and comment from City Hall. In April 2015, The City of Portland's Bureau of Planning and Sustainability (BPS) convened the Deconstruction Advisory Group (DAG), comprised of business and community members, to discuss policies related to deconstruction as an alternative to conventional demolition. Deconstruction – the systematic disassembly of buildings and removal of materials – mitigates many of the sustainability concerns surrounding demolitions while potentially generating economic benefits in the process. BPS and the DAG have recommended a policy requiring all homes built prior to 1917 or designated as historic resources to be deconstructed rather than demolished if removed. The requirement will take effect in October 2016.

BPS commissioned the Northwest Economic Research Center (NERC) to examine the economics of deconstruction in Portland, which are presented in this report as a detailed comparison of its costs and benefits relative to conventional demolition, and estimates of its overall effects on the local economy.

Throughout the research process, NERC worked closely with BPS and members of the DAG to identify relevant economic issues, data, and modeling inputs, which are summarized in the *Data and Methodology* section below. The relatively labor-intensive deconstruction process presents several advantages and some disadvantages relative to demolition. The details of each are explored in the *Cost Analysis* section of this report, followed by a summary of our *Economic Impact Analysis,* which utilized IMPLAN modeling to estimate the expected impacts of the new deconstruction requirement

Because any new economic policy presents tradeoffs for those it affects, and because wide-scale deconstruction activity would be virtually unprecedented, the *Conclusions* section closes the report with a discussion of the factors that will determine the success of the city's requirement.

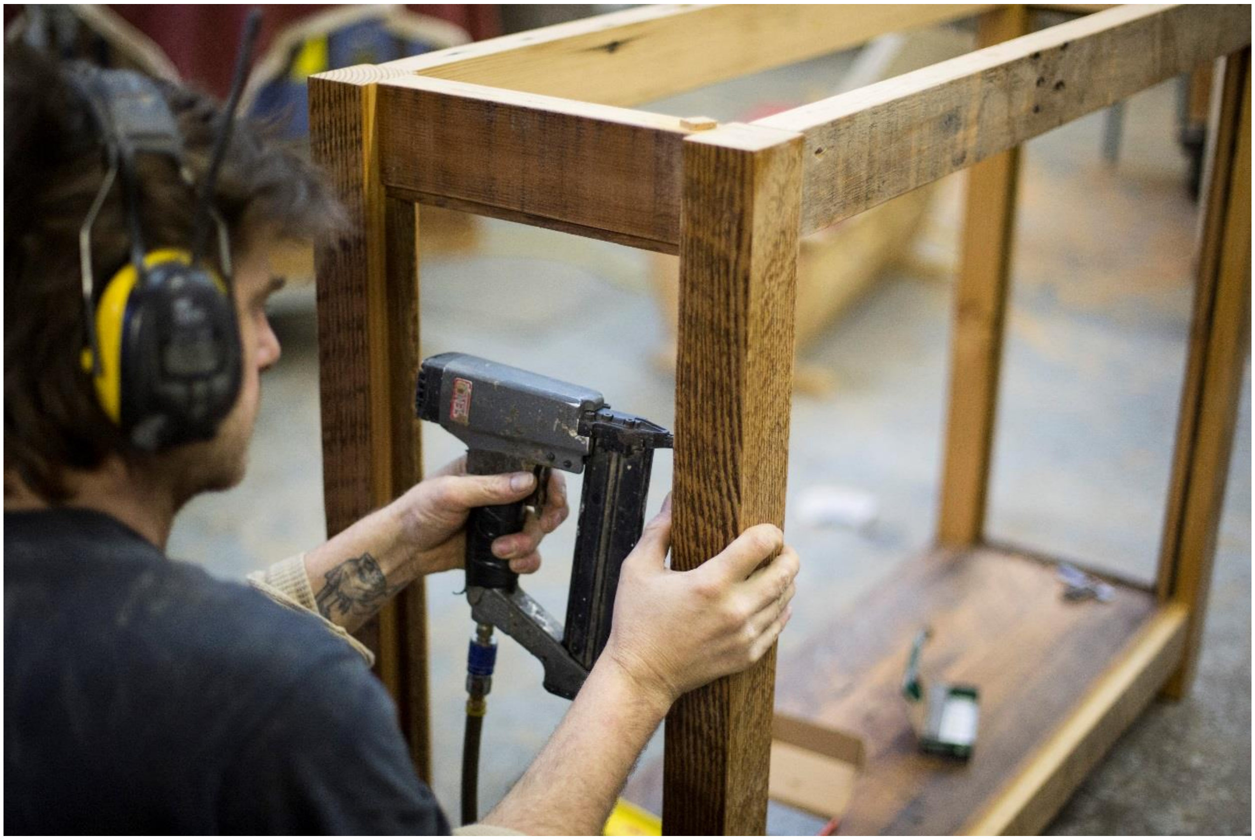

Photo: SalvageWorks

[Public domain], via Wikimedia Commons

METHODOLOGY

For our analysis of deconstruction and demolition costs, NERC worked with DAG members and BPS staff to compile data and other inputs. There are currently two organizations that perform essentially all full-house deconstructions in the Portland area – Lovett Deconstruction and non-profit The ReBuilding Center. Both provided NERC with records[5] of proposed and/or completed deconstruction projects, including detailed expense reports, project cost breakdowns, and financial statements. This information was used to generate cost figures for head-to-head comparison with demolition projects, and to construct spending patterns (or "production functions") for economic impact modeling. Local demolition cost figures are based on a limited sample (n=6) of permit applications for BPS's deconstruction grant program.

NERC based the average on-the-ground cost of deconstruction projects primarily on the records provided by the two local deconstruction providers. To this information we added details such as typical project time and crew size from direct input from BPS and DAG members; these details are easily verifiable against previous studies on deconstruction in other areas. The additional cost of foundation removal after a full-house deconstruction was assumed to be $4.60/square foot, based on informal web searches. For

[5] Most information provided by DAG members is confidential. Figures throughout this report are averaged, approximated, and/or expressed as ranges throughout this report to avoid disclosure.

demolitions, primary data was limited to reported project cost and structure size in square feet. We assume – with input from industry experts – that total demolition costs are fairly stable across projects, and that the industry's spending patterns (on administration, utilities, vehicles, supplies, etc.) generally follow those of the known details of the local deconstruction industry with two key differences. The first is that, due to its relatively capital-intensive nature, only 30% of demolition costs relate to labor (less than half of the labor costs' share of a deconstruction). Based on previously published research, we also assume that 40% of a demolition's cost comprised of disposal and recycling expenses.

NERC based economic impact scenarios on the expected direct effect of the proposed deconstruction requirement for the City of Portland. We estimate that the requirement would affect 110 – 140 candidate homes per year in the near future[6]. For modeling purposes, we assume 130 homes per year are deconstructed, slightly more than four times the number of full house deconstructions completed in 2014. Regarding the feasibility of this increase in business, neither organization we worked with doubted its ability – at least in the medium to long term – to expand and complete the new bids. The average size of recently deconstructed and demolished homes in our data sources is roughly 1,400 square feet, with an average footprint of 1,100 square feet. We treated these characteristics as representative of the 130 homes to be deconstructed.

On the opposite side of the coin, 130 additional deconstructions are 130 fewer demolitions. In this case, the lost sales, labor income, and employment associated with the change were entered as negative values for the demolition industry in the economic impact model (described below).

Additional model inputs included:

- Home construction total project cost (assumed to be $400,000 to $500,000)
- Construction loan interest rate (assumed to be 10%)
- 30-year fixed rate mortgage rates (assumed to be 5%)
- Average project time for deconstruction (assumed to be 10 - 15 business days)

Many of these assumptions were intentionally scaled to produce conservative estimates; importantly, none have a sizeable effect on the results below.

[6] Given the fixed requirement cutoff date, it is likely that the stock of candidate homes will naturally decline.

Economic Impact Model Description and Methodology

IMPLAN models are constructed using Social Accounting Matrices (SAM) based on spending and purchasing data from the Bureau of Economic Analysis (BEA) supplemented by data from other publicly available sources. SAMs are constructed to reflect the actual industry interactions in a region, and include government activities that are often omitted from this type of economic analysis.

SAMs create a mathematical "map" showing how money and resources flow through the economy. In a simulation, new economic activity is assumed to occur in an industry or group of industries. Based on past spending and purchasing patterns, IMPLAN simulates the purchasing and spending necessary for this new economic activity to occur. IMPLAN tracks this new economic activity as it works its way through the economy. In addition to following purchasing and spending through the private sector, IMPLAN also estimates the impact of changes in disposable income and tax revenue.

Each industry in the local economy is represented by a "production function", reflecting its connections to other industries. Economic changes or events are propagated through one production function into the next as new economic activity motivates additional economic activity in other parts of the supply chain, and through changes in spending habits.

IMPLAN breaks out analysis results into three types: direct, indirect, and induced.

- **Direct Impacts**: These are defined by the modeler, and entered in the appropriate industry. They are not subject to multipliers. In this case, the estimated new receipts of deconstruction firms, and the lost receipts of demolition firms, are entered as direct impacts into customized production functions for those industries.

- **Indirect Impacts**: These impacts are estimated based on national purchasing and sales data that model the interactions between industries. This category reflects the

IMPLAN Impacts

The impact summary results are given in terms of employment, labor income, total value added, and output:

Employment represents the number of annual, 1.0 FTE jobs. These job estimates are derived from industry wage averages.

Labor Income is made up of total employee compensation (wages and benefits) as well as proprietor income. Proprietor income is profits earned by self-employed individuals.

Total Value Added is made up of labor income, property type income, and indirect business taxes collected on behalf of local government. This measure is comparable to familiar net measurements of output like gross domestic product.

Output is a gross measure of production. It includes the value of both intermediate and final goods. Because of this, some double counting will occur. Output is presented as a gross measure because IMPLAN is capable of analyzing custom economic zones. Producers may be creating goods that would be considered intermediate from the perspective of the greater national economy, but may leave the custom economic zone, making them a local final good.

economic activity necessary to support the new economic activity in the direct impacts by other firms in the supply chain. For example, a deconstruction crew purchases hand tools, gasoline, recycling services, and other supplies necessary to complete the project.

- **Induced Impacts**: These impacts are created by the change in wages and employee compensation. Employees change purchasing decisions based on changes in income and wealth. For example, the model estimates the spending of new deconstruction crew members on retail goods, the resulting spending of retail employees on restaurant meals, the resulting spending of wait staff and cooks on entertainment, and so forth. Conversely, the foregone spending of demolition crew members cascades through the economy in a similar manner.

The model of the local economy created by IMPLAN is quite detailed, including representations of over 400 industries and multiple household income classes. However, because deconstruction is a small, burgeoning industry in the area, it is not yet represented by default. NERC built a customized deconstruction industry within the model, basing its production function on detailed financial information provided by DAG members. The labor and proprietors' (profit) income share of the industry's expenses was used to derive the expected increase accruing to households due to the City's requirement[7]. Additional output (sales) in the industry due to the requirement become wages, profit, and supply chain purchases in the model based on these actual linkages.

NERC also built a production function for the local demolition industry based on previous research, phone interviews with demolition businesses, DAG member input, and the production function of the broader "Maintenance and repair construction" sector within IMPLAN. NERC assumed a 5% profit margin for this industry. For this industry, the modeled impacts are losses of output, wages, profits, and supply chain spending. However, each additional deconstructed structure will still require a foundation excavation, which is often provided by the same demolition businesses that would be negatively affected by the requirement.

[7] This methodology is often referred to as "Analysis by Parts"

Photo: The Rebuilding Center

RESULTS AND DISCUSSION

Deconstruction and Demolition Cost Analysis

Based on actual records of proposed and completed deconstruction projects in Portland, a head-to-head comparison of gross full-house deconstruction costs and the costs of a demolition generally concurs with studies performed in other areas of the country. That said, somewhat unique local characteristics add important details to this picture.

It is widely understood that the gross costs of a given deconstruction project are higher than the costs of a comparably-sized demolition. The major sources of the cost gap between the two are their relative labor intensiveness and the share of project expenses dedicated to waste disposal. Deconstruction expenses are dominated by labor costs; crews of six to eight members methodically (and for the most part, manually) remove materials from a structure and sort them into waste, recyclables, and salvageable items. Salvageable wood, often the most prized material in older homes, must be de-nailed after it is removed. Similarly, interior lighting, kitchen, and bathroom fixtures require some manual processing. Deconstruction projects thus take considerably longer than a mechanical demolition, often ranging from ten to fifteen business days. The two organizations performing full-house deconstructions in Portland report that labor expenses make up close to 70% of a project's cost. Labor costs are also among a project's least variable. The non-profit ReBuilding Center, for instance, may not require the profit margins of a for-profit firm, but its employees participate in the same labor markets and face the same cost of living as the greater workforce.

In addition, a deconstruction crew does not remove the foundation of a structure or prepare the ground of a site for redevelopment, leaving the task to be completed mechanically at an additional cost. Input from local demolition providers suggests that foundation excavation and the associated tasks costs $4 - $5 per square foot, depending on site characteristics.

While deconstruction is associated with higher labor costs and longer project time, the process greatly reduces expenses related to waste disposal, which typically make up a large share (up to 40%) of a demolition bid. Much of a project's waste expenses, largely based on volume, are simply eliminated by segregating salvageable items from disposable and recyclable material during deconstruction. Other savings arise as salvageable material is transported locally to resellers, rather than traveling farther distances to recycling and transfer stations.

By contrast, a demolition crew of two to three members can entirely remove a structure and its foundation in two business days. We lacked detailed expense reports from local demolition firms, but previous research suggests that labor expenses constitute a mere 30% of a project's costs[8]. Waste disposal and recycling expenses are naturally higher for a demolition, wherein building materials are indiscriminately pulverized and transported *en masse* to recycling and waste facilities. Disposal expenses can comprise close to half of a demolition project's overall costs.

For a given structure size, overall demolition costs tend to be fairly consistent across projects. Deconstruction project costs are much more sensitive to site characteristics such as construction method, material composition, and the dimensions of a home. Locally, another important variable factors into overall cost. As noted, two organizations essentially split the local full-house deconstruction market. One of these organizations is the non-profit ReBuilding Center, which also operates a non-profit resale outlet for salvaged materials. As with any non-profit entity, The ReBuilding Center's business model, production costs, and service prices are not directly comparable to their for-profit counterpart. Table 1 summarizes costs based on the average 1400-square foot size of deconstructed homes in the last two years[9]. In the Deconstruction column, averages are weighted by the number proposed or performed projects by both non-profit and for-profit entities in our data, and then "fuzzed" to avoid disclosure of any confidential information. The average footprint of the homes in both data sources was 1,100 square feet.

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[8] Dantata, et al 2004; Chini, 2003; Guy and McLendon, 2001

[9] Interestingly, this figure is consistent with both deconstruction firms and the potential demolition projects recorded by BPS's Deconstruction Grant Program.

Table 1 – Single family residence gross demolition and deconstruction costs in Portland, OR

	Demolition	Deconstruction
Typical project time	2 business days	10-15 business days
Typical crew size	2 – 3	6 – 8
Estimated total labor hours	32 - 48	480 - 960
Estimated gross cost of structure removal (1400 sf home)	$10,300	$14,000
Estimated cost per square foot	$7.40	$10
Estimated additional cost of foundation removal	$0	$4,800
Total gross costs	**$10,300**	**$18,800**

The labor cost differential discussed above is evident in Table 1. Deconstruction projects in the local data available to NERC tended to run longer and involve much larger crews than comparably-sized demolition bids. The average structure removal cost per square foot was roughly 35% higher for deconstruction, translating to an approximately $4,000 difference for an average structure. The additional cost to remove and prepare a site's foundation after manual deconstruction increases the cost gap to more than 80% on average.

"The benefits of choosing to demolish a house directly accrue to builders and property owners. Much of a demolition's environmental burden is an external cost, borne by others."

Holding Costs

Beyond on-the-ground removal costs, it is important to note the costs that arise due to longer deconstruction processes. Construction loans, which carry much higher interest rates than conventional mortgages, are typically disbursed in increments (known as "draws") at each stage of a construction project. Payments on these draws are usually interest-only until construction is complete and the principle balance is packaged into a mortgage. This means that because deconstructions effectively prolongs the first stage of a construction project relative to mechanical demolition, additional holding costs are incurred by a new home's builder and/or buyer.

For example, assuming a new $500,000 project is financed with a construction loan at 10% interest, and that the first draw of the project is 25% of the total cost, a one-month delay would translate into an additional $1,025 interest payment. Deconstruction projects commonly add ten to fifteen business days to a project, which may be sufficient to generate a total delay of this magnitude.

Salvage Revenues

An important feature of deconstruction partially closes the cost gap between the two removal methods. Much of the material of a residential structure is reusable - and for older homes in particular, quite valuable. Pre-WWII homes were generally built using old growth, high quality lumber that has become prized for its clarity, character, and strength. A 1,200 square foot wood-framed home can generate 6,000 board feet or more of such lumber. Salvaged boards can be re-graded and reused for structural and non-structural building applications, or repurposed for aesthetic or artistic purposes. Bathroom and kitchen fixtures, windows, and hardware are likewise prized as characteristic, lower-cost alternatives to new items.

In practice, some salvaged material is used on-site in the new construction project (e.g., attractive cabinetry reinstalled in a new home; wood reused for finish applications). Any material not re-used on site can be sold[10] or donated to local resale outlets. Property owners intending to sell the salvage from a deconstruction project may do business with a reseller that specializes in reused material. In Portland, for example, several businesses buy reclaimed wood and sell both the raw material and furniture built from it. Others specialize in antique fixtures and hardware. According to local industry professionals, demand for materials is currently high in the area.

"The materials salvaged during recent Portland-area deconstructions had a median value of $19,700. If donated, they would generate a tax deduction ranging from $4,000 to $20,000."

Aside from directly selling salvaged materials, property owners may elect to donate materials to a qualifying non-profit entity that resells items at a steep discount from retail prices. Several locations accept and resell building material and interior items locally. Such donations are tax-deductible, meaning that their value is subtracted from the taxable income of the donating party. This translates to a reduction in personal income taxes proportional to a property owner's effective tax rate[11]. Parties making a donation worth $5000 or more must have the material professionally appraised. NERC obtained the records of a Portland-based assessor for twelve local deconstructed properties, and found that the value of salvaged materials ranged from approximately $10,000 to $50,000, with a median of $19,700. Records for eleven deconstructed properties in other locations showed a comparable range. Depending on the donor's effective tax rate, the reduction in taxes paid would have ranged from roughly $4,000 to $20,000.

The range of revenues generated by directly selling or donating materials for a tax deduction in Portland notably overlaps the cost difference between demolition and deconstruction of a structure. Ultimately

[10] Material may become the property of the deconstruction crew; in this case, its value can be seen as a discount applied to the crew's asking price for the deconstruction service.

[11] Cost accounting law may prevent this benefit for commercial property owners. Salvageable value in a property effectively increases the tax basis of the asset, so that claiming a donation simultaneously raises property income tax.

the cost difference and salvage revenues depend on multiple project-specific factors, but it is evident that, even in a competitive labor market such as the Portland region, the value of salvaged material substantially offsets the higher gross cost of deconstruction.

Environmental Costs and Sustainability

The external environmental costs of building demolition are well documented: construction and demolition (C&D) waste (most of which is renovation and demolition waste) comprises a large share of the region's landfill material, large amounts of this material is recyclable and reusable (particularly from older buildings), and mechanical demolitions are resource intensive and can result in the local release of hazardous materials.

The most recent local data available suggests that more than 20% of landfill-destined garbage originates from the construction and demolition (C&D) sector[12], and the City of Portland's Climate Action Plan, the *Portland Recycles!* Plan, and Metro's Enhanced Dry Waste Recovery Program all specifically address C&D waste as an important target for reduction. A typical demolition will produce approximately 60 pounds of solid waste per square foot of structure, excluding its concrete foundation. For the average 1,400 ft^2 home in our deconstruction and demolition data, this translates to 42 tons of landfill material per demolition project.

"Deconstruction greatly limits the risk of neighborhood asbestos exposure and contaminated material commingling with landfill trash."

Various sources[13] estimate that more than 85% of the waste generated by a residential demolition can be diverted from landfills if removed and processed by deconstruction. As noted, much of this material is typically reused on site, sold to reclaimed wood brokers, or donated to used building supply centers. What remains is either recycled or, in the case of wood, channeled into "energy recovery" streams. Besides its financial value (discussed above), salvaged materials "embody" considerable amounts of energy. For example, the wood in a home passed through several energy and carbon-intensive steps to arrive at the construction site. Given the need to replace discarded material, the preservation of a structure's "embodied energy" can be viewed as straightforward resource conservation.

Because materials are manually removed from a home and sorted, deconstruction avoids another especially salient environmental cost associated with mechanical demolitions: the release of toxic air, water, and ground pollution on site and at the landfill. As a building is pulverized and mechanically

[12] 2002 Oregon Solid Waste Characterization and Composition, Oregon Department of Environmental Quality. National estimates concur.

[13] *Deconstruction*, NAHB Research Center (http://www3.epa.gov/epawaste/conserve/imr/cdm/pubs/river.pdf); Overview of Deconstruction in Select Countries, CIB Report (http://www.cce.ufl.edu/publications/conference-proceedings/)

excavated into waste bins during a demolition, airborne particulate matter and dust containing asbestos, silica, mold, and fungus are released. A recent analysis performed by *The Oregonian* newspaper estimated that between 80% and 90% of homes being demolished in Portland contain asbestos, and that only 33% had asbestos properly removed between 2011 and 2014. In contrast, the relatively methodical removal of material from a home's interior during a deconstruction greatly limits on-site release, and contaminated material can be properly disposed of separately from other mixed debris. The US EPA and several other organizations have published deconstruction manuals and guides that detail hazardous material handling training for crews.

"More than 20% of solid waste in Oregon's landfills is generated by the construction and demolition (C&D) sector."

Photo: Lovett Deconstruction

Economic Impact Analysis

The results of NERC's analysis of deconstruction and demolition costs provide key inputs for a broader analysis of the overall economic impact of the City of Portland's deconstruction requirement. For this purpose, NERC used IMPLAN, an economic model that simulates the local economy and tracks the net effect of initial changes anywhere in its interlinked structure. A full description of IMPLAN can be found in the *Methodology* section above.

Put simply, the direct impacts of the new requirement are the estimates presented in the previous section. The requirement will mean additional deconstructions each year. In turn, higher output in the nascent deconstruction industry means additional spending on supplies, equipment, and other inputs, including workers' salaries and proprietors' income. By definition, the requirement also means fewer mechanical demolitions each year, lower spending by demolition businesses, and decreased employment and earnings in the demolition industry. The net cost difference between the two removal methods represents a loss of income to the party paying the difference[14]. Thus, the overall effect of the requirement depends on opposing changes in the two industries and the additional costs borne by property owners now required to use deconstruction rather than demolition.

Table 2 summarizes two illustrative modeling scenarios. Scenario A relies most importantly on an assumption that the net difference in cost between the two removal methods is approximately $10,000, a high-end estimate based on the deconstruction and demolition data. Note that this implicitly assumes that there is no offsetting revenue generated by salvaged materials for the new deconstructions. Scenario B incorporates the value of salvaged materials, assuming that the revenue or tax deductions gained through material salvage is sufficient to completely offset the higher cost of deconstructing a house (foundation removal costs remain, however).

[14] In reality, the incidence of the additional cost (i.e., which party in a transaction "absorbs" it) is difficult to predict and depends on the sensitivity to price of each party involved in the construction process. Certainly, in a real estate market characterized by very strong demand and somewhat constrained supply, one can expect that home buyers will ultimately bear some of the burden of this cost. For the purposes of impact modeling, it is the household income bracket of the party paying the cost, rather than its role as buyer or seller, that affects outcomes. For this analysis, we assumed that the parties ultimately paying the higher cost of a deconstruction had incomes reflecting the actual distribution of households in the Portland metropolitan statistical area.

Table 2 – Economic Impact Modeling Scenarios

Input	Assumption
Additional deconstructions/Fewer demolitions	130
Structure removal net cost difference	$10,000 (Scenario A), $0 (Scenario B)
Base construction project cost	$500,000
Construction loan interest rate	10%
Construction delay due to deconstruction	1 month
Additional cost of foundation removal after deconstruction	$4,800

For both scenarios, we assume an above-average construction project cost, high mortgage and construction interest rates (which factor into net losses and holding costs). Further, we assume that the delay in the construction process caused by longer deconstructions is sufficient to generate an entire month of holding costs (described above) for property owners. These assumptions are meant to reflect the geographic distribution of relevant properties and to ensure conservative estimates. Finally, the analysis required NERC to build customized industries within the IMPLAN model (described in the IMPLAN methodology section immediately below. While most characteristics of the local deconstruction industry are derived entirely on actual data shared by DAG members, we based some details of the model's demolition industry on previous results and professional advice.

Economic Impact Analysis Results

Table 3 summarizes the impacts of the City's requirement in each model scenario. Assuming deconstructed properties have no salvage value (Scenario A), the measure is estimated to have a small, but positive, overall impact on the local economy. This impact grows by about one third if we allow for modest revenues or tax deductions arising from the sale of donation of salvaged materials. Note that Scenario B assumes that deconstructed properties contain an average of approximately $4,000 in salvage, which is slightly beneath the lower bound suggested by actual data. The overall economic benefits of deconstructions grow as this value increases – a "waste to wealth" situation.

Table 3– Economic impacts of Portland's deconstruction requirement

	Impact Type	Employment	Labor Income	Value Added[15]
Scenario A	Direct Effect	***	***	***
	Indirect Effect	-0.1	-$9,672	-$13,885
	Induced Effect	1.2	$56,040	$93,291
	Total Indirect + Induced	1	$46,368	$79,406
	Total Effects[16]	**30-40**	**$1,000,000-$1,100,000**	**$1,100,000 – 1,200,000**
Scenario B	Direct Effect	***	***	***
	Indirect Effect	-0.1	-$9,672	-$13,885
	Induced Effect	3.5	$168,226	$283,478
	Total Indirect + Induced	3.4	$158,555	$269,593
	Total Effects[13]	**40-50**	**$1,200,000-$1,300,000**	**$1,500,000-$1,600,000**

The dynamics behind this small but positive outcome are fairly intuitive – the requirement increases activity in one industry, and decreases activity in another industry, with the financial balance (to the extent that it arises) paid by property owners. The positive result is due in part to the relative labor intensity of the deconstruction process. Deconstruction projects directly generate more income for workers than do demolitions. These workers by and large spend their new income, which stimulates additional economic activity. Conversely, a larger share of demolition revenues flow toward capital and supply chain purchases, with some portion "leaking" from the local economy. The additional costs paid by builders or property owners, similarly, contribute to local economic activity as does any increase in household spending.

Table 4– Industries most affected by deconstruction requirement

Industry	**Total Employment**	**Total Labor Income**	**Total Value Added**
Food services and drinking places	<1	$2,778	$3,947
Real estate establishments	<1	$1,414	$8,709
Private hospitals	<1	$4,803	$5,338
Offices of physicians, dentists, and other health practitioners	<1	$5,694	$5,838
Nursing and residential care facilities	<1	$1,994	$2,270
Retail Stores - General merchandise	<1	$1,688	$2,888

Activity in one industry necessarily impacts other related industries. As Table 4 illustrates, the most-affected sectors are closely associated with the consumer spending[17]. Impacts are generally small, and

[15] Value Added equals the sum of workers and firm proprietors income. It can be viewed as Gross Regional Product, the regional expression for Gross Domestic Product (GDP)
[16] Ranges reported for confidentiality reasons
[17] This table reflects Scenario A; Scenario B results are nearly identical.

largely reflect the spending induced by the new income of local deconstruction crew members. Also as expected, the most negatively affected industries (not tabled) are those associated with capital-intensive demolition activity – waste management, motor vehicle parts, and industrial machinery repair and maintenance.

Photo: The ReBuilding Center

CONCLUSIONS AND DISCUSSION

The recent wave of residential demolitions in Portland presents a familiar dilemma between private incentives and social outcomes. The city's economy and diverse communities continue to attract and retain residents, and this growth is necessarily accompanied by rapid redevelopment. In such an economic environment, demolitions provide the fastest and least expensive option for builders and property owners wishing to clear and prepare a site for new construction. However, in a broader sense, financially inexpensive demolitions generate substantial costs that aren't fully captured in a project's price tag. Large volumes of landfill waste, hazardous materials exposure, and avoidable resource consumption are costs largely borne by external parties.

Deconstruction directly mitigates these externalities; the price tag of a deconstruction can thus be viewed as partially "internalizing" the true costs of structure removal while, as it turns out, providing net benefits to the local economy despite its higher upfront expense. Those benefits arise not only from avoided environmental costs, but from job creation and the preservation of the economic value in older homes. The City of Portland's deconstruction requirement applies to the area's lowest-hanging fruit in this regard: older homes that are well-built from high quality materials that should not be pulverized and buried in most cases. Still, the City is breaking new ground with the new policy, and there is additional work remaining to maximize its success.

Consideration 1: Deconstruction sector development

The first important consideration hinted at in this analysis is the relative immaturity of the deconstruction industry in this region. Two organizations, each with a very different business model than the other, perform virtually all full-home take-downs in Portland. While representatives from both organizations have expressed confidence that their operations can expand to meet the impending wave of demand, it is important to note the potentially rapid increase that will follow the requirement's implementation. Needless to say, the construction projects that will now require deconstructions are highly time-sensitive. If the two-firm deconstruction sector encounters significant friction in its efforts to ramp up hiring, training, and logistical operations, the delays to construction projects would be a large and avoidable downstream loss. Support for the current deconstruction contractors as well as new firms would strengthen and deepen the market, benefiting the contractors, their customers, and other related industries.

The other side of this issue is the oft-cited employment potential of an expanded deconstruction industry. Deconstruction work largely mirrors semi-skilled and skilled construction work, providing solid-wage jobs for crew members and a pathway to higher-skill construction positions. If the City's requirement, crafted primarily from environmental sustainability concerns, increases the size of the industry to the magnitude expected, then the workforce-development that follows would be an opportunity for even larger returns to the local economy.

Consideration 2: Salvage market development

A network of niche markets for salvaged building material has grown around Portland's deconstruction industry. Full-house deconstructions, as well as partial "skim" deconstructions currently provide diverse salvage vendors with low-cost inventory, and demand is currently high for reused and repurposed materials. However, effectively tripling the number of full-house deconstructions (as the new requirement is expected to do) will likewise represent a multi-fold increase in salvaged materials hitting the local markets. While it is possible that some salvage can be economically transported to other destinations, it is important that local surpluses be avoided. As illustrated above, the net economic benefits of the new requirement depend in part on the value that builders and property owners can extract from a house when it is deconstructed. Like the collective investment Portland residents will make as deconstructions are phased into the housing market, efforts to support salvage market development will ensure long run returns to the economy.

Consideration 3: Building for Deconstruction

The limited scope of the City's deconstruction requirement allows housing market participants some leeway in adopting deconstruction and salvage methods. Over time, it is likely that the returns to deconstruction projects will attract additional contractors and naturally expand the practice into more recently-built structures, both residential and commercial. However, a hefty share of the nation's building stock was constructed with materials and methods that will not lend themselves to profitable deconstruction. Since the 1970's for example, builders have increasingly used inexpensive dimensional lumber, plastic and synthetic finish material, and adhesives in new homes. A clear compliment to widespread adoption of deconstruction will be a return to construction methods that are compatible with disassembly and material reuse. In other words, "green building" incentives should also apply to construction with an eye toward both long-lasting materials and modularity. Several organizations in the US promote such practices.

Photo: The ReBuilding Center

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