Economic Development Quarterly
Volume 22 Number 4
November 2008 303-315

10.1177/0891242408325701
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Portland's Green Building Cluster

Economic Trends and Impacts

Jennifer H. Allen
Thomas Potiowsky
Portland State University, Oregon

This study offers an initial exploration of the green building cluster in Portland, Oregon. Specific objectives include assessing how the factors identified in Michael Porter's "diamond" support the green building industry cluster in this region, describing the trends in terms of growth and expansion in the sector, and, where possible, providing quantitative data to document the impact of this industry cluster. The authors suggest that Portland has a robust and competitive green building cluster that is supported by many of the elements described in Porter's diamond—local and export demand, a critical mass of leading-edge firms, strong supporting institutions, qualified employees, and a robust supply chain. The study also identifies areas in need of additional support to realize the full potential for economic development in this cluster and offers an approach to mapping the green building cluster that may also inform analysis of other emerging sustainability clusters.

Keywords: *competitiveness; cluster; green building; Portland*

The city of Portland and the state of Oregon have both identified the green building industry as an area of opportunity. Architectural, design, and development businesses in the region are recognized as national leaders. As of September 2007, Portland had the highest number of Leadership in Energy and Environmental Design (LEED) certified buildings in the country, followed by Seattle and Chicago (U.S. Green Building Council [USGBC], 2007a).[1] Recognizing the economic opportunities related to green building, the Oregon state legislature recently funded the Oregon Built Environment and Sustainable Technologies Research Center, which will focus in part on commercialized research related to green building technologies.

This article offers an initial exploration of the green building cluster in Portland, Oregon. Specific objectives include assessing how the factors identified in Michael Porter's (1990) diamond support the growth of a green building industry cluster in this region, describing the trends in terms of growth and expansion in the sector, and, where possible, providing quantitative data to document the impact of this industry cluster.

Developing more credible information about the nature of green building as a cluster and the trends in business development, job creation, and revenue generation in this sector may help to sustain support for government policy commitments and research and educational investments targeted at growing and maintaining the competitiveness of this sustainability cluster. In addition, this information may help identify areas in need of additional support to realize the full potential for economic development in this area. This assessment may also inform analysis of other emerging sustainability clusters.

Method

Because codes of the North American Industry Classification System (NAICS) do not capture those activities in the building industry that constitute green building, a traditional input–output model is not well suited for the analysis. This study adapted the methodology used for an assessment of the green building cluster in Seattle, Washington (Berk & Associates, 2005), relying on a combination of surveys and interviews targeted at "key informants" to develop an understanding of the characteristics of the industry cluster. The study also used these informants to help estimate the

Authors' Note: The following individuals were extremely helpful in providing information for the study: Mike Abbate, Clark Brockman, Eden Brukman, Blair Bubenik, Terry Campbell, Jay Coulson, John Echlin, Kristy Edmark, Gina Franzosa, Chuck Halling, Randy Hansell, Kellee Jackson, Lee Jimerson, Mike O'Brien, Sean Penrith, Jennifer Riehl, Kelly Rodgers, Paul Schwer, Dennis Wilde, and Renee Worme. Oregon's Department of Labor was also helpful in providing data for this project.

percentage of overall building activity that involves green practices in Portland, using the figures developed for the Seattle study as a baseline. Using these ranges, we developed estimates of the wages related to green building based on data from the overall construction industry.

Fifteen individuals or firms were interviewed or responded to a questionnaire for this study. Respondents included developers, green building consultants, and representatives of architecture firms, landscape architecture firms, engineering firms, wood products companies, certifying organizations, and nonprofits.[2] This study is more limited in scope than the Seattle study referenced above because of time and resource constraints as well as the availability of some types of data such as the volume of sales. (Because Oregon does not have a sales tax, such data are not readily accessible.) Despite this more limited focus, the study provides a starting point for developing a better understanding of the dynamics and impacts related to this emerging industry.

Background

Green Building: Definitions and Context for Study

Globally, there are a number of different frameworks for characterizing green buildings, including USGBC's LEED Green Building Rating System (www.usgbc.org), the Green Building Initiative's Green Globes System (www.greenglobes.com), Earth Advantage (www.earthadvantage.org), the U.S. Department of Energy's High Performance Building Standards (www.eere.energy.gov/buildings/highperformance/), the BRE Environmental Assessment Method (www.bream.org), and Building for Environmental and Economic Sustainability (http://www.bfrl.nist.gov/oae/software/bees/), among others. The USGBC's LEED Green Building Rating System dominates the commercial green building field in the United States. Currently, more than 3 billion square feet of building space nationally is covered by the LEED program (USGBC, 2007b).[3]

Interest in green building has been growing rapidly since LEED was launched in 2000. The USGBC (2007b) estimates that the annual U.S. market in green building products and services was more than $7 billion in 2005 and was expected to increase to $12 billion in 2007. The 2006 *Green Building SmartMarket Report*, published by McGraw-Hill Construction (2006), estimated that by 2010, between 5% and 10% of all new nonresidential construction is expected to be designed using green building principles, which would represent an investment of between $10.2 and $20.5 billion.

This study focuses on the green building industry in the Portland area encompassing Clackamas, Multnomah, and Washington Counties.[4] The city of Portland has been actively supportive of the green building sector for a number of years; recently, Clackamas County has also made green building a central focus for its economic development strategy (Clackamas County Fifth Community Congress, 2007). In 1999, Portland's Energy Office launched a "Green Building Initiative" focused on how the city could support "resource efficient and healthy building practices." Since then, the city's Office of Sustainable Development (successor to the Energy Office) has developed an active green building program that provides information, education, technical assistance, and financial resources to the green building industry. The state of Oregon also recognizes the economic opportunities related to green building. In 2007, the Oregon state legislature funded the Oregon Built Environment and Sustainable Technologies Research Center to focus in part on commercialized research related to green building technologies. The Oregon Economic and Community Development Department has been convening members of the green building industry to identify what more could be done to support the development of this industry as an economically competitive cluster.

Clusters

Economic clusters have been described as "geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agreements, and trade associations) in particular fields that compete but also cooperate" (Porter, 2000, p. 15). Although the roots of modern cluster theory reach back to Marshall's (1890/1920) treatment of the "externalities of industrial location" in his *Principles of Economics,* more widespread application of cluster analysis to industrial development began to emerge in the 1980s. Markusen's (1985) assessment of the steel industry in Chicago and Storper and Christopherson's (1985) assessment of the motion picture industry in Los Angeles both contributed to the understanding of how clusters contribute to economic development. Markusen used input–output models to capture the economic exchanges within a sector, whereas Storper and Christopherson drew attention to the greater resilience clusters provide to a regional industry, allowing it to adapt to changing markets and other economic trends.

Sternberg (1991) expanded the approaches taken in earlier studies to encompass the role of technological relationships between companies, the role of educational

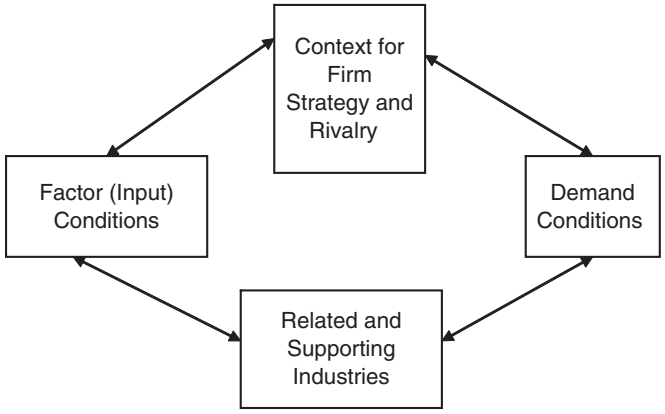
and research institutions, and the availability of skilled labor. Challenging the reliance on input–output models to assess a cluster's health, Sternberg emphasized that the interrelationships between businesses that contribute to the health of a cluster extend beyond sales transactions to include "marketing, subcontracting, technological learning, interrelationships in product procurement and quality management, and the shared development of complementary educational institutions" (p. 352).

Since the early 1990s, Harvard Business School professor Porter has championed the concept that industry clusters play a critical role in competitiveness and successful economic development. Porter (1998a) describes a cluster as a "system of interconnected firms and institutions whose value as a whole is greater than the sum of its parts" (p. 213). Compared to traditional assessments of companies, industries, or sectors, a cluster framework can help capture "important linkages, complementarities, and spillovers of technology, skills, information, marketing and customer needs that cut across firms and industries" (p. 205). In addition, viewing a group of companies as a cluster can help identify "opportunities for coordination and mutual improvement in areas of common concern" and can provide a "constructive and efficient forum for dialogue among related companies and their suppliers, government and other salient institutions" (p. 205).

Successful clusters can affect competition in several ways—by increasing the productivity of constituent firms or industries, by increasing their capacity for innovation and productivity growth, and by stimulating new business formation that supports innovation and expands the cluster (Porter, 1998b). Porter developed the now well-known diamond characterization of how clusters contribute to the productivity of an industry (Figure 1).

This study used the diamond framework to assess the dynamics of the green building cluster in Portland and to map the trends in the region in terms of job growth and business expansion.

Figure 1
Porter's Diamond



Context for Firm Strategy and Rivalry:
- A local context and rules that encourage *investment* and *sustained upgrading* (e.g. intellectual property protection)
- *Meritocratic* incentive systems across institutions
- Open and vigorous competition among *locally based rivals*

Demand Conditions
- *Sophisticated and demanding* local customers
- Local customer needs that *anticipate* those elsewhere
- Unusual local demand in *specialized segments* that can be served nationally and globally

Related and Supporting Industries
- Access to capable, locally based *suppliers* and firms in *related fields*
- Presence of *clusters* instead of isolated industries

Factor (Input) Conditions
- *Presence of high quality specialized* inputs available to firms
  - Human resources
  - Capital resources
  - Physical infrastructure
  - Administrative infrastructure
  - Information infrastructure
  - Scientific and technological infrastructure
  - Natural resources

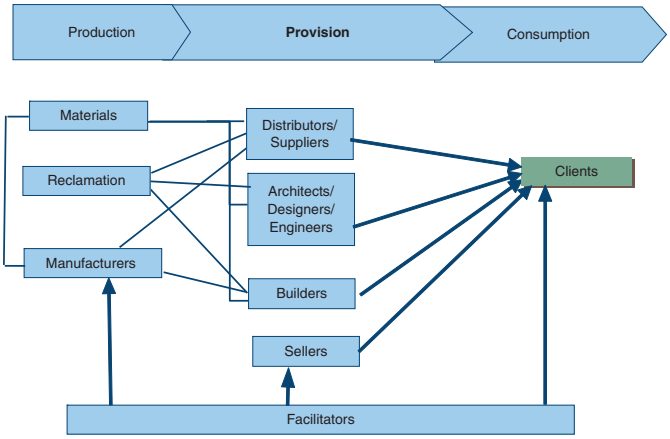
Source: Adapted from Porter (2006).

Applying Cluster Analysis to Green Building

The green building cluster represents a subset of the businesses, institutions, policies, and other factors that support the building industry. Figure 2 offers a graphic representation of the elements that are represented in a green building cluster, and Table 1 offers examples of the types of products, services, firms, and other organizations that populate such a cluster. In many aspects, both the industry segments and players are similar to those in the broader construction industry. However, there are a number of reasons why this subset of a broader industry merits consideration as a cluster in its own right.

Although relationships within the established building sector provide a foundation for interactions in the green building cluster, green building practitioners require additional relationships to achieve their goals. Designing buildings that meet green building standards requires that the various players in the construction process—developers, architects, engineers, landscape architects, and so on—start to work together as a team far earlier in the process than is the case in more traditional building to introduce environmental design considerations upstream and ensure an integrated design approach (U.S. Department of Energy,

Figure 2
Green Building Cluster



2006). Integrating more environmentally friendly products and services into the built environment also requires the development of new supply chain relationships, which either steer existing suppliers to produce new products or support the emergence of new businesses providing these new products and services. The need to assess the performance of such new materials and technologies similarly triggers the need for additional supporting institutional structure. All of these attributes argue for treating the firms and supporting infrastructure around green building as a cluster distinct from the overall building industry.

Applying a cluster framework to a "sustainable" or "environmentally friendly" subset of an industry poses analytical challenges. Porter's work and most other cluster analyses use publicly available data sets such as employment and income data. As Colgan and Baker (2003) note, these analyses are better suited for assessing

Table 1
Green Building Industry Cluster "Players"

Production	Provision	Consumption	Facilitators
Materials	Distributors and Suppliers	Clients	Institutions
Wood	Lumber	Private individuals	State
Steel	Paint	Private companies	Cities
Sand and gravel	Fixtures	Governments	Counties
Concrete	Appliances	Nonprofits	Universities
Glass	Furnishings	Utilities	USGBC[a], Cascadia
Asphalt	Other building materials		Northwest Eco-Building Guild
Straw	Landscaping materials		NW Energy Efficiency Alliance/Daylighting lab
Petrochemicals	Architects, designers, and engineers		Society of Building Science Educators
Reclamation	Architects		Forest Stewardship Council
Salvaged wood fixtures and other materials	Engineers		American Institute of Architects
Harvested urban trees	Landscape architects		International Interior Design Association
Manufacturers	Green consultants		Sustainable Building Advisor Program
HVAC	Interior designers		Master Builders Association
Toilets	Lighting designers		Building Commissioning Association
Lighting fixtures	Builders		Building Professionals of America
Solar panels	General contractors		Oregon Department of Energy
Appliances	Construction managers		Oregon Natural Step Network
Plumbing	Subcontractors		Energy Trust of Oregon
Flooring	Sellers		Builders Owners and Managers Association of Portland
Roofing	Real estate agents		
Siding	Lenders		
Drywall	Title and escrow		
Paint	Inspectors		
Windows			
Carpet			

Source: Modeled after Berk & Associates (2005, Exhibit 2).
Note: Production, provision, and consumption lists assume green products and services provided or demanded.
a. U.S. Green Building Council.

clusters that have already formed and are already reflected in economic data than for clusters that are in the process of forming—or, in this case, emerging clusters whose interactions are defined by attributes that are not captured in NAICS codes, such as environmental attributes. However, Sternberg (1991) notes that a cluster approach does allow investigation of emerging sectors, commenting that "in many regions, the most interesting sectors may not be well-established ones, but rather clusters of firms whose incipient and emerging interrelationships can be strengthened through policy" (p. 353).

To address the analytical constraints noted above, the study relied on interviews with key informants from the green building community in Portland and on statistics related to trends in green building certification in the region. (It is widely recognized that many green building activities are not captured by certification statistics; as a result, the estimation of green building activity provided by tracking these projects should be considered a conservative estimate.) Estimates of the percentage of overall construction activity in the Portland region involved in green building activities were developed with input from the regional green building community, using the ranges used in the 2005 assessment of green building activity in Seattle (Berk & Associates, 2005) as a baseline for these estimates. These estimates were then used to calculate the approximate value of these green building activities in terms of wages paid in the Portland region.

Portland's Green Building Cluster

The presence of the types of industry segments and players listed in Figure 2 and Table 1 does not in itself prove that Portland hosts a competitive green building cluster; the nature of the relationships between these segments and players needs to be taken into account as well. Porter's model identifies four primary conditions or regional characteristics that are needed to support the development of an economically competitive cluster:

1. demand conditions—strength of local and export demand
2. factor conditions—costs, infrastructure, resources, and scientific and technical knowledge in the region, for example
3. related and supporting industries—especially those providing for local sourcing of products and services
4. firm strategy and rivalry—cooperative and competitive relationships among firms in the cluster

These categories provide an organizing framework to assess the cluster dynamics and related economic trends of the green building sector in the Portland area.

Demand Conditions in Portland

Colgan and Baker (2003) identify four dimensions of market potential that deserve attention in assessing a cluster:

- *Local demand:* Strong local demand helps an industry become more competitive as suppliers can get to know customers and their needs easily, and the high standards set by local customers force suppliers to produce better products that can be exported outside the region.
- *Export demand:* Industries that sell their goods and services in competition with firms outside the state tend to have higher productivity rates and therefore contribute significantly to a region's prosperity.
- *Extent to which the markets served are growth markets versus mature markets:* Demand expands more rapidly in growth markets compared to mature markets, which tend to grow at about the same pace as the economy as a whole; as a result, clusters that create or serve growth markets are particularly important in terms of economic development impact.
- *Breadth and diversity of markets served:* A cluster should ideally develop a diversity of products serving a number of different markets.

Without exception, those consulted for this study indicated that they had observed significant growth in the demand for green building in the region during the past 5 years. One green building consulting firm noted that although they estimated the national percentage of green construction activity at 5% to 7%, in Portland they estimated activity might be 3 times higher than the national average. Results of a survey of the adoption of voluntary environmental practices in Oregon in 2004 indicated that nearly 15% of all new projects were constructed to green or high-performance standards in that year. The value of this construction amounted to approximately $900 million (Ervin et al., 2007). Of the construction facilities responding to this survey, 33% reported constructing approximately one third of their overall projects to green standards (Jones, 2007)

The growth trends for green building appear to be accelerating in the region; one firm noted that whereas

between 2000 and 2006, it had completed 5 LEED projects, in 2007 alone it worked on 16 LEED projects. One firm interviewed for the study noted that almost 100% of the public owners it currently deals with in Portland request a LEED rating for their projects, whereas the percentage of private owners requesting LEED was about 50% and growing. One construction firm estimated that 15% to 20% of the commercial construction projects in Portland have some element of green building incorporated in them.

The number of completed and registered LEED projects in the region substantiates the observations made by respondents that demand in the region is significant and that it outpaces demand elsewhere in the country. As of September 2007, Portland (city proper) had the highest number of certified buildings in the country (32), followed by Seattle (31) and Chicago (27) (USGBC, 2007a). Considered on a per capita basis compared to these other larger cities, this figure is even more significant. The 44 LEED certified buildings in Multnomah, Clackamas, and Washington Counties combined represent almost 6 million square feet of real estate (USGBC, 2007a). A number of respondents noted that there is a significant amount of green building activity that is not reflected in LEED certification statistics, suggesting that the overall level of activity is even higher than these statistics suggest.

When asked about other indicators of demand, several firms noted the significant increase in the number of requests for proposals that are being issued for green building projects in the public and private sector, the number of new contracts their firms were obtaining related to green building, and the related increases in staffing requirements. All of the firms interviewed indicated that they would be expanding their green building–related services; in the cases where the firm's central focus is green building consulting, staffing was expected to grow significantly. One green building consulting firm described growth in the past 2 years as "almost exponential" in response to demand both within the region and elsewhere; its staffing has tripled since 2005, and both revenue and the total number of projects have increased fivefold during this time as well. As of September 2007, this firm had certification of 30 projects and currently has 150 active projects, 90% of which were seeking LEED certification.

These growth trends were noted by firms of all types—developers, architects, engineering firms, landscape architects, consultants, and suppliers. One landscape architecture firm in Portland noted that almost every project it worked on now has a green or sustainable element to it, compared to a decade ago when most of the demand was for traditional landscape projects. The million dollar investments that both Honda and Toyota have made in the region on sustainable landscape management were cited as one sign of the scale of investment in these activities. Portland's leadership was also apparent in this area. The same firm estimated that although 5% of landscape architecture work at the national level might be oriented toward green or sustainable practices, the percentage in Portland may be closer to 30%.

The rate at which building leases are filled (known as the lease-up rate) is another indicator of the demand for green buildings in Portland. According to a leading developer, one condominium in Portland's Pearl District sold out 10 months before completion, and 90% of another condominium's units sold out more than 9 months before the building was completed. (In addition to offering an indicator of the demand at the retail level for green buildings, these lease-up rates represent a direct economic value to the developer because of the avoidance of vacant inventory.)

Most of the firms interviewed work primarily in the commercial building sector, where green building activity has been concentrated. Although green building in the residential sector still lags the commercial sector in terms of overall percentages, growth in demand in this subsector is also significant. Earth Advantage staff estimate that more than 10% of the 17,000 to 20,000 homes built in Oregon annually are being built to the Earth Advantage program standards (R. Hansell, Earth Advantage, personal communication, September 13, 2007). The recent launch of LEED for Homes by USGBC is likely to increase the percentage of activity in the residential sector. The growth trends for Earth Advantage homes described in Table 2 as well as the similar growth trends for Energy Star homes offer additional evidence of the demand in this sector.[5]

In addition to the robust trends in local demand for green buildings noted above, most of the firms interviewed indicated that there were "huge and growing" opportunities for them outside the region. The percentage of business that the firms conducted in the Portland area ranged from 25% to 80%. Several firms indicated that the demand for their sustainability-related services outside the region had been growing significantly, with the percentage of their work done outside of Portland also growing as a result. One green building consulting firm noted that the opportunities for growth outside of Portland were in fact greater than in the region because of a maturing marketing in Portland, the relatively small

Table 2
Residential Building:
Energy Star and Earth Advantage

Earth Advantage: Annual and Cumulative Certifications Since 2000	
Year	Number of Certified Homes
2000	14
2001	46
2002	445
2003	911
2004	1,113
2005	1,450
2006	2,590
2007	1,190[a]
Cumulative	7,759[a]

Source: R. Hansell, Earth Advantage, personal communication, September 13, 2007.
Note: The table above documents the growth in Earth Advantage certifications in Oregon and southwestern Washington since 2000; Earth Advantage staff estimate that approximately 5,000 of these homes are located in the greater Portland area.
a. Through July 2007.

size of Portland's market overall, and the fact that firms in Portland are further along in internalizing green building expertise.[6]

The geographic scope of Portland firms is already extensive and expanding. The green building consulting firm noted above is currently working in 17 states and has opened a second office in Florida. However, none of the firms interviewed had plans to move their headquarters from Portland, in part because Portland's perceived leadership in the field offers a significant marketing advantage. Architecture, landscape architecture, construction, and engineering firms all shared the observation that Portland's reputation for excellence in sustainable design helped strengthen export demand for Portland-based firms.

In terms of the other considerations noted by Colgan and Baker (2003), the rates of growth in this sector described above clearly distinguish the green building market as a growth market rather than a mature market. In terms of breadth and diversity of markets, the sector encompasses commercial, industrial, and residential construction activities, with strong demand from both the public and private sectors. The sector is also reaching into the broader infrastructure development markets, driven in part by the development of LEED for Neighborhoods, which extends USGBC's certification into neighborhood design, and community-level commitments to green development, such as Shady Cove's recent commitment that all development would meet Earth Advantage standards.

In summary, there is strong evidence that demand for green building in Portland is significant and growing rapidly. At the same time that the demand for green building in Portland has outpaced demand in other parts of the country, Portland firms are experiencing increased demand for their expertise outside of the region, in part because the region is viewed as a leader in this field. The early emergence of discriminating demand for green building locally appears to have provided firms with the opportunity to develop leading-edge expertise in this field, positioning them competitively to take advantage of export opportunities.

Factor Conditions

Factor conditions supporting a cluster include the availability of adequate and appropriate human resources; the relative costs of doing business in a region; informational, physical, and other types of infrastructure, including the policy framework; the availability of natural resources; and the scientific and technical knowledge in a region. Assessing the nature of these factors in Portland reveals both strengths and weaknesses in factor conditions. Overall, however, this exploration provides additional evidence of the robust nature of this sector in the region.

Employment trends indicate that Portland's green building industry is robust and growing. Employment growth has been significant for many of the firms consulted for this study, and firms clearly linked this growth to the increased investments in green building. One architecture firm has grown from a staff of 37 in 2002 to a staff of 95 in 2007, an engineering firm had grown to a staff of 60 from 48 a year ago, and one green building consulting firm has grown from 15 to 43 employees since 2005. Most of the firms contacted for this study indicated that they were adding additional green specialists in their organization, making certification as a LEED accredited professional (LAP) a requirement for certain positions. One leading developer, for example, indicated it would be requiring that all of its project managers be LAPs by 2008.

Given these demand trends, the availability of accredited professionals in the Portland area is an important consideration. As of August 2007, there were 821 LAPs in the Portland metropolitan statistical area (MSA; USGBC, 2007c). Although this is a robust figure, it lags the number of LAPs in several other metropolitan areas, including the Chicago MSA (1,928), Atlanta MSA (2,369), Houston MSA (956), Dallas MSA (926), and Philadelphia MSA (888).

In addition, there is a shortage of qualified staff in some areas, in part because the demand for expertise in these areas has grown but also as a result of a lag in the supporting educational and training infrastructure. Several firms noted that it is very difficult to find qualified people in certain engineering fields as well as in energy modeling and commissioning.

Mitigating these challenges to some extent is Portland's reputation as a leader in green building and its broader commitment to sustainability, which allow firms to attract high-quality staff from across the country. As the tagline of one firm—"Importing Talent, Exporting Sustainability"—suggests, this firm is attracting extremely highly qualified individuals from all over the country, many of whom are attracted to Portland because of the critical mass of activity and expertise in green development and the quality of life. One engineering firm that has experienced employment growth of 25% in recent years indicated that its reputation for sustainable design has greatly improved its recruitment nationally (P. Schwer, PAE Engineering, personal communication, August 3, 2007). In recent years, the firm has hired engineers from Pennsylvania, Ohio, Maryland, Colorado, Kansas, Alaska, and California. A leading developer also noted that the firm's sustainability focus had contributed to its ability to attract very "progressive and qualified" individuals.

The presence of supporting institutions is another factor critical to a cluster's success, and the number of such institutions in the Portland area is impressive (see Table 1). Institutions identified by interviewees included, among others, the Oregon Natural Step Network, the Urban Land Institute, the Energy Trust of Oregon, the Oregon Department of Energy, Portland's Office of Sustainable Development, the University of Oregon's Daylighting Lab, Better Bricks, and the Builders Owners and Managers Association of Portland. The presence of leading green building consulting firms, including Green Building Services and Brightworks Northwest, was also cited as an asset to the region.

Industry associations are also critical to help foster and maintain relationships among firms in a cluster, provide regular means of communication, share resources to address common needs, and showcase industry trends and issues (Colgan & Baker, 2003). Respondents across the board referenced the Cascadia Chapter of USGBC as a key regional resource providing education, communication, and leadership in the field. This organization was also cited as helping lead the regional industry beyond LEED to consideration of "living buildings" and other innovative approaches. Firms noted that this push toward "continuous improvement" would likely help the regional industry maintain its national leadership in innovation.

Universities and research organizations that provide high-quality, relevant educational and research resources are other important contributors to the development of a competitive cluster (Colgan & Baker, 2003). Many of the institutions noted above provide education, training, and research support; however, there appears to be a need for additional educational programs as well as research and development in the region. As previously noted, there is a shortage of personnel in building energy systems, building commissioning, and some engineering fields. The demand for additional research and development services was illustrated by the strong support the green building community expressed for the recent establishment of the Oregon Built Environment and Sustainable Technologies Research Center, a joint effort of Oregon State University, Portland State University, the University of Oregon, Oregon Institute of Technology, and the Pacific Northwest National Labs, which focuses on green building and green development in addition to clean energy and bio-based product development.

The relatively low cost of doing business in Portland compared to cities such as San Francisco and Seattle was noted by several firms as a regional advantage. The region's rich natural resource base in terms of wood products and bio-based products was also identified as an asset, although there are some tensions around forest certification schemes, specifically those related to the LEED credit for wood certified by the Forest Stewardship Council (FSC). Although a number of firms expressed frustration that there was not more FSC-certified wood available in the region, this certification scheme is controversial among some in the timber industry who consider its requirements to be either excessive or inappropriate for the region's ecological conditions.

An additional factor that has played a significant role in the development of the green building industry in the region is the supportive policy framework at the state and local levels. Although several firms noted that some building codes and permitting processes continue to pose challenges to green building projects, the incentives provided by the Oregon Business Energy Tax Credit and the State Energy Loan Program and the resources provided through the Energy Trust of Oregon were widely noted as providing meaningful support to the sector.

Summary Comments on Factor Elements

The region's competitiveness in green building is supported by a number of strong factor conditions, including the presence of institutions that support networking, training, and technical assistance, a supportive policy framework, and a relatively strong pool of LAPs. The rate of growth in jobs in the sector offers one indication

of the economic health of the sector. However, there are gaps in terms of education and training and the availability of qualified engineers and other technical experts. The recent investments in developing the regional research capacity for the sector should strengthen support for the cluster in this area.

Firm Strategy and Rivalry

Porter (1990) identifies the extent to which there is both open and vigorous competition between locally based rivals and frequent cooperation between firms in an industry as other attributes that are essential to a well-functioning cluster. The interdisciplinary nature of green building may make the density and richness of interactions between firms even more critical to the function of the cluster than would be the case in the more traditional building industry.

It is clear both that there is a critical mass of firms with expertise in this area and that firms both compete and cooperate with each other. When asked to estimate the percentage of the building industry in Portland involved in green building activities, several firms indicated that they believed 100% of the firms are involved, driven by owners' interests in achieving LEED status or equivalent. "Green building may not be [these firms'] raison d'être, but it has become a service that all architects, [general contractors], and [subcontractors] offer in their portfolio of services," noted one firm (B. Bubenik, Hoffman Construction, personal communication, July 30, 2007).

Another firm estimated that 50% to 80% of architecture and engineering firms and 50% of general contractors in commercial building are involved in green building, with perhaps 50% to 60% of total commercial building activity including some form of green measures. One construction firm estimates that 75% of architects in Portland have had experience with at least one green building.

In terms of competition, most respondents indicated that they competed with local and regional firms, and several respondents indicated that they also frequently competed with national firms for their work. In some areas, the amount of work available mitigated most conflict around this competition; as one firm noted, there is "plenty of work for everyone" (J. Coulson, Green Building Services, personal communication, August 2007).

In addition, several firms commented that Portland had a more collaborative culture than did other communities they were familiar with and that this culture provided a rich foundation for shared learning and innovation in the region. Several firms noted that they would frequently team with competing firms on projects. The regional energy around innovation beyond LEED and the related support for continuous improvement in green building practices noted above also relate to this aspect of cluster development, as a regional culture that supports ongoing innovation provides a strong foundation for the industry's continued national competitiveness.

Related and Supporting Industries

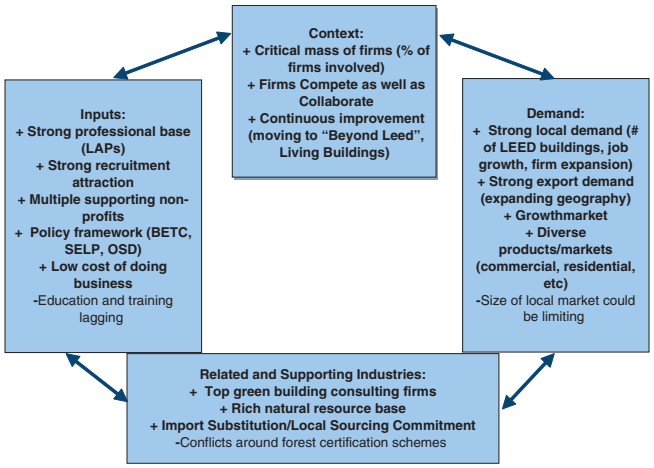
Having regional businesses that can supply key inputs into an industry is another important factor needed to support a strong industry cluster. In addition, the materials that are sourced from within a region contribute to the overall economic impact related to that sector's activity. In the case of green building, the voluntary LEED credit that projects can qualify for based on materials that are sourced from within 500 miles of the project site creates an added incentive to find existing suppliers or foster new suppliers within this geographic range.

Several firms indicated that their first choice is to buy local, both in their projects and for their office supplies and other expenditures. One architecture firm estimated the value of locally sourced office products and services at $1 million in 2006. Although this is an indirect economic impact of the sector, it is important to recognize the impact of such expenditures. The approximate value of this firm's projects in design or construction that year was $500 million. One construction firm noted that between 30% and 35% of the products used in its projects come from within 500 miles, representing around $45 million in value. A developer referenced the LEED Local/Regional Materials credit that they had earned for several recent projects as an example. (This credit requires tracking the percentages of total material costs that are either extracted or manufactured locally or regionally.) In these projects, the cost of locally manufactured products ranged from 21% to 26% of total project cost, and the locally extracted products ranged from 54% to 89% of total project cost.

Most of those interviewed indicated that local supply chains were relatively robust, although some products and services such as some types of glass are not as readily available in the region. An assessment contracted by the Portland Development Commission and the Office of Sustainable Development on import substitution is helping to provide information about areas where economic development opportunities could be expanded through the development of green building products and services that are currently not available in the region.

The presence of several green building consulting firms in the region who are national leaders in the field was cited by several firms as offering a significant advantage to the

Figure 3
Portland's Green Building Cluster Characteristics



Note: LEED = Leadership in Energy and Environmental Design; LAP = LEED accredited professional; BETC = Oregon Business Energy Tax Credit; SELP = State Energy Loan Program; OSD = Office of Sustainable Development.

green building sector in the region. In addition, as noted above in the discussion of factor conditions, Oregon's rich natural resource base was cited as an asset to the green building community; there may be additional opportunities to expand the regional supply of bio-based products through the work of the Oregon Built Environment and Sustainable Technologies Research Center.

Discussion of Portland's Green Building Cluster

Figure 3 summarizes the main elements related to Portland's green building industry. As this figure illustrates, all of the elements of the cluster contribute to the success of the sector, including local and export demand, a critical mass of leading-edge firms, strong supporting institutions, qualified employees, and a robust supply chain. As Sternberg (1991) emphasized, the interrelationships between businesses that contribute to the health of this cluster in Portland clearly extend beyond sales transactions to include "marketing, subcontracting, technological learning, interrelationships in product procurement and quality management, and the shared development of complementary educational institutions" (p. 352). Together, these factors provide a foundation for innovation and growth in this field.

Portland's green building cluster appears to support the competitiveness of firms in the region in several of the ways that Porter (1998b) has posited: by increasing firms' capacity for innovation and productivity growth and by stimulating new business formation that supports innovation and expands the cluster. The growth rates and national leadership of the cluster in this region offer significant economic development benefits, including job creation, increased revenues, and growing demand for Portland-based firms in other regions of the country. "Place" matters—firms clearly see being located in Portland as a meaningful advantage, in terms of both the levels of local demand and the branding opportunity related to Portland's reputation as a leader in this field.

Initial Observations on the Economic Value of Portland's Green Building Sector

The initial intention of this study was to conduct an assessment of the economic value of green building in Portland equivalent to that conducted by Berk & Associates (2005) on behalf of Seattle's Office of Sustainability and Environment and Office of Economic Development. Such an extensive assessment was not possible, however, because of the lack of access to some of the types of data used in the Seattle study and resource constraints.

The interviews in the study do offer a few anecdotal examples of the financial value of green building activities at the firm level. For example, the value of one architectural firm's active projects in 2006 was $500 million; another firm estimated the value of its locally sourced materials in 2006 at $45 million. However, additional information about the actual economic value of the sector to the region would also be helpful in understanding its relative impact on the economy and wealth creation in the region.

One economic indicator—payroll data for three counties that are the focus of this study—was analyzed for this study, using the assumptions in the Seattle study as a baseline with some adjustments. The Seattle study estimated the economic activity related to green building by developing a minimum and maximum range for the NAICS categories considered to represent the green building industry in the region (see Table 2). Using this methodology, the study estimated Seattle's green building–related wages as between $60 million and $195 million in 2002.

Several factors were taken into account in terms of how these percentages might inform the Portland study. First, Portland has more LEED-certified buildings than does Seattle, despite being a smaller city. Second, the Seattle study used 2002 wage data, and growth trends for green building have been significant since this time. Third, the Seattle report explicitly noted that Portland had a number of policies in place that made it more supportive of the green

Table 3
Estimated Wages Paid in the Green Building Sector

Clackamas, Multnomah, Washington Counties, 2006	Total Payroll ($)[a]	Min %	Max %	Green Building: Minimum Value ($)	Green Building: Maximum Value ($)
Architectural, engineering, and related services	687,174,117	8	22	54,973,929	151,178,306
Construction of buildings	617,469,320	4	17	61,746,932	104,969,784
Residential building construction	282,132,792	11	15	28,213,279	42,319,919
Industrial building construction (part)	53,118,422	4	15	2,124,737	7,967,763
Commercial and institutional building construction (part)	282,218,106	8	18	22,577,448	50,799,259
Heavy and civil engineering construction[b]	274,381,945	4	12	10,975,278	32,925,833
Specialty trade contractors	1,417,147,754	4	12	56,685,910	170,057,730
Other services to buildings and dwellings (part)	12,899,275	4	11	515,971	1,418,920
Remediation services (part)	16,159,535	4	11	646,381	1,777,549
Clay product and refractory manufacturing	18,077,862	4	11	723,114	1,988,565
Primary metal manufacturing	342,241,099	4	11	13,689,644	37,646,521
Fabricated metal product manufacturing	480,989,700	4	11	19,239,588	52,908,867
Merchant wholesalers, durable goods	1,437,520,340	3	11	43,125,610	158,127,237
Wholesale electronic markets and agents and brokers	539,662,625	3	11	16,189,879	59,362,889
Furniture and home furnishings store	122,828,438	3	11	3,684,853	13,511,128
Building materials and garden equipment and supplies dealers	184,919,570	3	11	5,547,587	20,341,153
Real estate	486,832,417	3	11	14,604,973	53,551,566
Total	7,255,773,317			355,265,114	960,852,990

a. Payroll information provided by the Oregon Labor Department Information System (2007).
b. Not included in Seattle study.

building cluster than Seattle was at the time. For these reasons, it seemed reasonable to use, as a baseline percentage, figures that are slightly greater than those used in the Seattle study—conservatively, one additional percentage point was used for the minimum and maximum values in the range in most cases. In some cases, information provided by respondents or other data supported using maximums that were higher than this.

Table 3 provides the calculations for the green building–related payroll for the tricounty area in 2006. (Note that the Standard Industrial Classification codes used for the Seattle study have been replaced by NAICS codes that use slightly different categorizations for industry sectors.) This methodology results in an estimate that green building wages in the Portland area in 2006 ranged between $355 million and $960 million, compared to $60 million to $195 million for Seattle in 2002. Given the growth in green building since 2002, the ranges used in Table 3 should be considered very conservative. This assessment does not extend to the analysis of revenues, taxes, or the indirect economic benefits associated with green building activity. Additional research into these impacts would provide a more robust estimate of the economic contributions of the sector in the region.

The exploration of economic impacts from green building clusters has important policy implications. If government programs are to be directed to assist this cluster, policy makers must know the economic contributions to their region. State and local governments face a wide spectrum of businesses and communities vying for the limited resources devoted to economic development. In addition to highlighting its smaller carbon footprint, the green building cluster needs to establish its economic footprint. It makes little sense for governments to assist if they cannot measure the probable return on their investments. This line of inquiry will also assist governments in the type of policy that is best suited to promote this cluster, be it investment tax credits, building codes, development grants, or other policy instruments.

Summary and Conclusions

This study indicates that there is a thriving green building cluster in the Portland region and that this cluster has seen significant—even exponential—growth in recent years. The vibrancy of this cluster can be attributed to many of the factors identified in Porter's diamond as important to

cluster competitiveness. These include strong local demand for green building projects in the private and public sectors; a critical mass of firms that both compete and collaborate; a strong foundation of supporting institutions, including supportive policies, incentive programs, and technical assistance and networking organizations; a rich pool of talent; and the ability to attract top-notch professionals from across the country. Challenges to the continued growth of the industry include the lag in the education, training, and research and development capacity in the region and the relatively small size of the Portland market overall.

Applying a cluster framework to a "sustainable" or "environmentally friendly" subset of an industry poses analytical challenges because of the lack of data sets that capture the types of attributes that distinguish green building from construction generally. This study offers a qualitative approach to mapping the cluster that may inform analysis of other emerging sustainability clusters.

In addition, although this research does not offer a comprehensive quantitative assessment of the economic contribution that the green building cluster is making to Portland, several indicators are provided that give a sense of the magnitude of these contributions. The conservative estimate of wages in the Portland area associated with the green building sector suggests that these wages add up to between $355 million and $960 million on an annual basis. This assessment did not extend to analysis of revenues, taxes, or indirect economic benefits associated with green building activity, which would significantly increase the contribution the sector makes to the region.

The exploration of economic impacts from green building clusters also has important policy implications, and further pursuit of this line of inquiry will assist governments in the type of policy that is best suited to promote this cluster, be it investment tax credits, building codes, development grants, or other policy instruments.

Appendix
List of Firms Interviewed or Surveyed by Questionnaire

Earth Advantage
Cascadia Chapter, U.S. Green Building Council
The Collins Companies
David Evans and Associates
Gerding Edlen
Green Building Services
Greenworks
Hoffman Construction
PAE Engineering
Portland Office of Sustainable Development
SERA Architects
Walsh Construction

Notes

1. Leadership in Energy and Environmental Design (LEED) is a registered trademark of the U.S. Green Building Council (USGBC). In accordance with USGBC's usage guidelines, use of *LEED* in this document will not include the registered trademark symbol.

2. The interview protocol is available from the authors. The appendix provides a list of firms contacted.

3. LEED ratings are based on performance in five areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality. Registering a building with the USGBC indicates the builder's or owner's intention to seek LEED certification. On completion, buildings can achieve basic certification or silver, gold, or platinum LEED ratings depending on their scores in each of the five areas noted above.

4. Green building activities in Oregon appear to be concentrated in the Portland metropolitan area. According to the publicly accessible lists of LEED-certified and registered projects produced by the USGBC, 73% (45 of 63) of certified or publicly listed registered projects in the state of Oregon were located in Multnomah, Clackamas, and Washington Counties (USGBC, 2007a; note that not all registered projects are publicly listed, so the overall number of projects may be higher than noted here).

5. Energy Star is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy. It certifies products and homes based on energy efficiency criteria. In 2006, approximately 2,300 homes in the Northwest were certified under the Energy Star program, compared to 988 in 2005. Although a downturn in the housing market slowed home construction in the region, there is evidence that Energy Star homebuilders have been able to distinguish themselves in the marketplace because of their quality product (Northwest Energy Efficiency Alliance [NEEA], 2006). Both the Portland-area and the Puget Sound–area Multiple Listing Services have also agreed to include the Energy Star Homes Northwest designation and green buildings in general as search options in their listings, suggesting a growing market demand among realtors and households for homes with these features (NEEA, 2006). Earth Advantage was launched in 1999 and certified its first homes in 2000.

6. In some cases, the opportunities for expansion in other regions are limited by competition by larger firms at national levels, geographic distance, and the staff's interest and ability to travel. The cost of marketing in distant markets and concern about the carbon footprint of travel are also limiting factors noted by some firms.

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Jennifer H. Allen is associate director of Portland State University's Center for Sustainable Processes and Practices. She previously worked for the Oregon Economic and Community Development Department and the World Bank. Her research focuses on sustainable economic development, green building, and sustainable agriculture.

Thomas Potiowsky is the Oregon State Economist and a professor of economics at Portland State University. His research interests include the U.S. macroeconomy, regional and state economic growth, and forecasting. He is a member of the Oregon Progress Board and the Oregon Council on Economic Education.