

Who Plays and Who Decides

The Structure and Operation of the Commercial Building Market

A Report Prepared for the
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and Community Programs

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Report Summary

Introduction

The purpose of this report is to characterize the commercial new construction market in order to better understand the needs and operation of the market, to more effectively identify needed technologies, and to identify effective strategies to diffuse the technologies being developed by the U.S. Department of Energy.¹ The report is primarily based on the analysis of secondary data collected from the Internet, the analysis of data from the Department of Energy, Energy Information Administration, Commercial Building Energy Conservation Survey, and other available data.

The study examines the social and cultural trends that will influence how buildings will be constructed and used in the future. It also examines how decisions are made with respect to the design, construction, and renovation of buildings. Seven sub-markets within the commercial building market – office, retail, food sales and service, lodging, healthcare, warehouses, and education – are examined in detail. The size and characteristics of buildings in each sub-market are described along with the ownership of the buildings and the operation of the sub-markets. The report contains detailed lists of large players. The energy use characteristics of the buildings in the market and the penetration of energy efficient measures into the sub-markets are discussed as well.

Major Findings

Three important themes emerged from this analysis.

- The use, design, construction, and operation of commercial buildings will change significantly in the next 25 years in response to dynamic forces within culture and society.
- There is significant potential to promote a substantial amount of energy efficiency by targeting the relatively few large players in each sub-market.
 - In nearly every sub-market, there is a relatively high degree of concentration of ownership or franchising of establishments.
 - These owners/users are large national and regional firms.
 - The extent to which these large players may already be attending to energy efficiency is not known. Some players seem quite sophisticated in this regard while others do not.

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- There are large numbers of smaller independent players at the regional and local level that can benefit from energy efficiency as well.
 - Within the various sub-markets, these players are fairly homogeneous.
 - Strategies to target the independent players need to be implemented by public benefits agencies, energy efficiency organizations and utilities at the local level.
 - The understanding of these local commercial establishments and the sophistication of the strategies presently being used to deal with them vary but are typically not high.

Recommendations

While there have been large numbers of successful energy efficiency programs and hundreds of evaluations of these programs, program design and implementation are still largely ad-hoc processes that often fail to build upon lessons of the past. DOE can provide a leadership role in using the results of the many evaluations to systematically build scientifically based program designs and implementation strategies for the commercial sector and then propagate those designs in order to accelerate the adoption energy efficiency.

Key recommendations from this report are that DOE:

- Develop a plan and commit resources to continuously and systematically update its understanding of the commercial building market, to make greater use of commercially available secondary information to increase DOE's understanding of the commercial building market, and to access secondary information through partnerships and relationships with firms and associations that are already collecting this data.
- Develop a plan and commit resources to continuously and systematically identifying and tracking trends that will influence the construction and use of buildings in the future and systematically incorporate this information into planning efforts. This includes closely tracking emerging efforts to design and build commercial buildings using component methods, the use of high tech materials in buildings, and the social and cultural trends that may result in changes to building use patterns and the need for commercial buildings.
- Commit resources to increasing DOE's understanding of the decision makers in the commercial building community and identifying the parameters and value propositions that inform decision-making across situations.
- Initiate support, and/or participate in sub-market specific events such as workshops, strategy forums, and conferences that involve the largest players and their trade associations in each of the major sub-markets to increase DOE's understanding of relevant issues in the major sub-markets, the long-term direction of the sub-markets, sub-market technology needs, changing decision-making structures, and key decision criteria.
- Commit to planning, developing, and implementing a national energy efficiency strategy that targets large national firms that franchise or have large property holdings in the major commercial sub-markets through one-to-one national level marketing ef-

forts. Effectively targeting large national and regional firms requires a national strategy that involves partnering with the major players, the trade associations to which they belong, other Federal agencies, national and regional market transformation organizations, state energy offices, and others.

- Target smaller regional and local players by:
 - Partnering and coordinating with other government agencies, regional and local energy efficiency organizations, trade associations and others to develop science based implementation strategies, programs, and materials that can be adapted by energy efficiency, environmental, and or utility organizations at the state regional and local levels.
 - Developing and implementing a strategy to recruit regional and local organizations to implement the science based strategies.

Executive Summary

Introduction

The Department of Energy, Office of Building Technology, State and Community Programs, contracted with Innovologie, LLC, to characterize the commercial new construction market in order to better understand the needs and operation of this market and more effectively identify and diffuse the technologies that it is developing to the market. The commercial building market includes but is not limited to offices, retail, healthcare, hospitality, public assembly, education, and worship.

The goals of this project were to identify:

- The types and kinds of new commercial structures that are being built and will be built in the short- and long-term
- The levels of commercial new construction activity by locale and by types and kinds of structures
- The number and size of players – including developers, owners, architecture and engineering firms, especially the major national and regional players
- The interactions among the players including patterns of association and information exchange
- Segments within the market where the players share similar patterns of decision-making, capital use, or technology needs
- The process by which new commercial building construction is completed and the forces at work within the process that influence the energy efficiency of buildings
- The individuals and firms within the market who are looked to by others and who influence trends
- The forces at work that are changing the way players relate to one another and the way they make decisions
- The strategies that might accelerate and increase the acceptance of energy efficient technologies and whole building design concepts

As was originally envisioned, the project was to complete a review of information from secondary sources and a set of interviews with key players in the market. As it turned out, the availability of materials from secondary sources was much more extensive than was originally thought. The information from secondary sources was so informative that it seemed prudent to use the available resources to analyze the existing information and postpone the interviews until the various sub-markets within the commercial buildings were more fully understood. Thus, this report is based largely on the analysis of existing data.

Also, at this stage of the research, understanding regional variations seemed to be less important than understanding the variations among the various sub-markets. Conse-

quently, most of the effort in this project was devoted to gaining a detailed understanding of the sub-markets and little effort was directed to understanding regional variations.

Because markets are dynamic, some effort was expended in examining future trends in the various sub-markets. In doing this, we found that there are some broad drivers of societal change that are likely to significantly influence buildings in the future. These are discussed in some detail below. In addition, we examined the specifics of the seven sub-markets: office, retail, food sales and service, lodging, healthcare, warehouses, and education.

As we examined these sub-markets, several themes emerged.

- The use, design, construction, and operation of commercial buildings will change significantly in the next 25 years in response to dynamic forces within culture and society.
- There is significant potential to promote a substantial amount of energy efficiency by targeting the relatively few large players in each sub-market.
 - In nearly every sub-market, there is a relatively high degree of concentration of ownership or franchising of establishments.
 - These owners/users are large national and regional firms.
 - We do not know to what extent these large players may already be attending to energy efficiency issues. Some players seem quite sophisticated in this regard while others do not.
- There are a large numbers of smaller independent players at the regional and local level that can benefit from energy efficiency as well.
 - Within the various sub-markets, these players are fairly homogeneous.
 - Strategies to target the independent players need to be implemented by public benefits agencies, energy efficiency organizations and utilities at the local level.
 - The understanding of these local commercial establishments and the sophistication of the strategies presently being used to deal with them varies but is typically not high.

Trends that will influence commercial buildings

In a dynamic technological society, projecting a future based on recent trends is likely to be misleading. As we examined the commercial building market, we identified trends that have the potential to change the demand for and the functions of commercial buildings. The major drivers of change in the future are likely to be:

- An increasingly digital world that links computers, communications, print, audio, and video technologies.
- Transportation and logistics that will influence how people move across the landscape and change the way people shop and the way products are delivered.
- Nanotechnology that will significantly alter the products and services that are available.

- Changes in energy production and consumption requirements including the rise of alternative forms of energy, distributed production of energy, reduced energy requirements.
- Manufacturing and production techniques that will result in mass customization and portable factories.
- New materials that will change the properties of the physical objects in our world.

Some examples of the potential effects of these trends for commercial buildings are:

The digital world

- Wiring and optical cable in buildings will be replaced by wireless technologies.
- Wireless technologies will increase the potential for monitoring and controlling the operation of buildings.
- Smart sensors and controls will adjust the office environment to respond to the person using the space.
- Fast high quality audio and video communications will result in a substantial increase in telecommuting and the use of satellite sites reducing the need for central offices and increasing physical space and communications requirements in homes.
- Multiple individuals will use an office space at different times, the equivalent of “hot bunking” in the Navy.
- Fast high quality multi-way audio and video communications will reduce the need for travel and same location conferences impacting both the travel and lodging industries.

Transportation and logistics

- High quality communications will result in a substantial increase in on-line shopping making the retail market more competitive and reducing the relative number and size of physical shopping locations.
- In turn, this will drive logistics and that will increase the availability, reliability, and timeliness of direct delivery. That in turn will increase the products available for delivery and decrease the relative number of locations offering products.
- Shopping, as we know it, will become less a matter of dealing with necessities and more a form of entertainment. This will influence the location, size and configuration of stores. Shops will increasingly be owned or franchised by manufacturers such as Rockport, Nike, and Apple and will be designed to entertain, to promote brand, as well as to deliver products. Shops will become centers for buying “customized products.”
- Small retailers who do not adapt to the new retail reality by utilizing digital technology and logistics will fail.
- Necessities will increasingly be purchased through one stop shopping at supercenters.

Manufacturing

- Digital technologies will increase the ability for “mass customization,” that is, the ability to make products specific to the individual. Products will be delivered directly rather than through stores.
- Warehousing and manufacturing will become more closely linked as warehousing takes on the new distribution functions. This will drive changes in warehousing space needs. Office and processing space that has been limited in warehouses will increase in response to the need to deal with new distribution functions.
- Manufacturing sites will become smaller.
- Manufacturing sites will become portable.
- Computer aided design, computer aided manufacturing, and computer aided engineering (CAD/CAM/CAE) will be ubiquitous and at the heart of design, manufacturing, and construction.
- Automated tools will result in flexible manufacturing plants that will produce a wide assortment of goods rather than plants dedicated to specific products.
- Buildings will be constructed with mass customized components rather than being “stick built.”
- Mass customized buildings will offer greater opportunities for quality control and energy efficiency.

Materials

- There will be lighter, stronger, more durable materials resulting in buildings that are lighter, stronger, and more durable.
- Designer materials will make it possible to specify the characteristics of materials such as thermal conductivity to be used in buildings.

Nanotechnology

- Nanotechnology will result in better controls and new comfort technologies that will change the way in which buildings operate.
- Nanotechnology, electronics, and biotechnologies will result in cheaper, smaller, and more sophisticated instrumentation, controls, and medical treatment technologies. Functions that require large scale, sophisticated, and expensive technologies and that are now performed in such places as hospitals, laboratories, and other large scale settings will become smaller in scale, cheaper, and will move to offices and even to homes. This will result in a reduction in the need for hospitals and other similar large-scale facilities, as we know them.

Some of these changes are already underway, some are imminent, and others may seem somewhat fanciful. Where people work and live, how they use space, and what people do within spaces is going to change radically over the next 20 to 50 years. *DOE should be thinking about how these changes will affect its focus on commercial buildings.*

There is an urgent need for basic research on how people and organizations affect and are affected by the buildings within which they live and work. We know some things about buildings and people but not very much about most of the effects. For example, we know a fair amount about how levels of illumination influence task performance. We are beginning to get some inkling about how daylight may affect people. There is some current research that shows how different types of comfort systems may influence productivity or satisfaction. However, we have very little understanding and no theory of human potential. We know almost nothing about comfort. We do not know what comfort is and we do not know what about it might be important. As a result, we do not know how comfort may be enhanced or negated by the built environment. *Theories and research about human potential should be driving the choices of technologies and how they are developed rather than developing technologies and then understanding their impact on humans.*

Decision-making

There are at least five potentially important sets of decision makers: capital providers, developers, users, building professionals, and community regulatory interests. The key decision maker varies with the situation.

Capital providers set the limits on a project by placing a value on the features and amenities in a building. The key decision point with respect to a new commercial building is establishing the budget and the financing. If energy efficiency or other features are not part of the plan at this point, it becomes very difficult to incorporate them into a project. Especially for large projects, financing arrangements may be very complex and therefore difficult to change once completed. Financing is difficult to change for small projects as well. There is a need to recognize that decisions about energy efficiency must come early and that tools and information are needed to aid in its early adoption.

Developers are another important set of decision makers. Often they are part of multi-line businesses that bring together the investors, the designers, the contractors, and the users. Developers, as represented by the investment managers, are interested mostly in return on investment. Large developers/owners have staff to whom they delegate the details such as calculating return on investments for such things as energy efficiency projects. Managers pick and choose among the alternatives.

Developers have general investment strategies. These strategies set the parameters within which investments are made. The investment strategies encompass a much broader set of issues than energy efficiency. There are many opportunities to invest money in buildings. Among other things, one can upgrade a lobby, increase the speed of the elevators, buy improved maintenance equipment, upgrade space for a tenant, invest in energy efficiency, or buy another building. Each item represents an opportunity and has potential for return on investment.

Users are a third important category of decision makers. It is important to think in terms of users rather than owners because users may be either lessees or owners. As we shall see, the majority of buildings are small and owner occupied. As we shall also see, users who lease space often have significant control over the amenities in the space, including energy efficiency. Decisions regarding how space can be used and modified in leased buildings are subject to negotiation between the lessee and the owner or the owner's rep-

representative. The lease is important in terms of energy efficiency and energy costs. In many instances, leases are structured so that the costs and benefits of energy efficiency are not split. The notion that the commercial sector is difficult to deal with because of split incentives may only be true for a very small percentage of commercial properties, perhaps 15 percent or less.

One of the key issues with respect to the role of **building professionals** is the degree to which they are able to integrate their efforts. Depending on the organizational model that is used to manage construction, building professionals may have more or less influence over decision-making.

In a traditional architect driven plan/design/build model, the owner engages the services of an architect through personal contacts or through a competitive solicitation. The architect is responsible for developing a concept and managing efforts of other professionals such as engineers in developing detailed plans and specifications. The architect may supervise the bidding and may manage and supervise the construction. Alternatively, a general contractor may manage the construction effort. Theoretically, this leads to a well-integrated building but the process can be time consuming and costly. Under the pressures of time and cost, the traditional model has given way to the design/build model.

In the design/build model, a developer or general contractor may manage the construction process. Detailed plans are limited to what is needed to complete the structure. The general contractor or a structural subcontractor will often lay out and build the structure based on a pre-existing template. Building professionals such as architects and HVAC engineers have a limited design role providing the elements essential to completing the building. The general contractor may erect the basic structure. The architect will “paint a picture of the skin of the building.” A space planner may work with a client to define the space. An HVAC engineer or contractor may “lay out” the heating and cooling system. An electrical contractor or lighting company may specify most of the lighting. These tasks are typically completed serially based on the exchange of CAD files to convey information. Information exchange may be limited to the information needed to define the specifications and resolve issues that may arise.

The benefits of the design/build model are that design time is at a minimum, costs are kept low, and the timeline for the building is streamlined. The problem with buildings completed using the design build model is that they can and frequently do have poorly integrated systems that do not work well and therefore the building performs poorly.

The collaborative model is an attempt to produce better buildings by focusing resources on building a team that has in place organizational, management, computer design knowledge, and quality control systems to overcome the deficiencies of the design/build model. Rather than leaving integration to chance, the team attempts to create understandings and systems so that members have expectations about what they will do.

Financing is the key limiting factor. Whichever model a developer or owner uses, professionals are limited in what they can do by the constraints of finance. Quality buildings and energy efficiency are intertwined. Quality buildings are a function of the organizations that build them and much more needs to be known about organizing for quality construction. *DOE may want to consider providing leadership, research and support in the quality building movement.*

Community regulatory interests set codes and standards that represent a performance threshold that all builders and developers must meet. The standards are typically a compromise between high levels of energy performance and cost considerations. Codes lag technical performance potential but represent a way to incrementally improve the performance of the building stock. There is evidence from California that codes and standards are mostly followed once they are adopted.

Projects often utilize “value engineering” to meet budgets. While the original intent of value engineering was to provide better or more functionality at the same or lower cost it has come to mean reducing function in order to meet budgets. *This often means eliminating controls and/or using less expensive equipment that potentially reduces the performance of a building. Value engineering may occur in 30 percent of projects.*

Developers and users need to see energy efficiency as part of the larger context for long-term operation of the building, its impact on building operations, and its effect on asset value. Small increases to net operating income from reducing energy costs can result in very large increases in asset value. When owners and designers are making trade-offs between building features and energy efficiency, there may be some situations in which energy upgrades may be expensed after a building is completed. In these cases, it may make sense to plan for energy efficiency upgrades and install them immediately after the building is completed rather than at the time of construction.

Target the few to influence the many

Large-scale office developers, mall developers, and chains or their franchisees complete a large percentage of new construction. Developers have internal and external design teams, and chains and retailers have their own “image architects and designers” who specify the designs and the content of the design. In this report, we demonstrate a method, network analysis, for understanding who participates in these teams. A key point is that this significantly limits the number of firms and individuals that may need to be influenced in order to impact the energy efficiency of large amounts of commercial space. A second key point is that the activities of the large developers and the chains must be influenced at the regional and national levels rather than at the local level. This represents a significant potential opportunity to impact large amounts of new construction, but it requires national level leadership as well as partnering at regional, state, and local levels.

Regional or local developers or general contractors often construct buildings that are built for local owners. These buildings are built using the design/build approach as well. The key decision-makers remain much the same. Strategies for reaching these owners and developers are probably best implemented at the local level. National and regional organizations such as DOE have an important role to play in developing such strategies.

Office sub-market summary

With respect to the office sub-market we found that:

- In 1999, there were about 740,000 office buildings and 12 billion square feet of office space in the U.S.

- About 75 percent of non-public office space, totaling about six billion square feet, is owner occupied. Commercial lease space represents about one-quarter of the non-public market space or three billion square feet.
- This means that for three-quarters of existing office space, split incentives, which are often cited as a barrier to achieving energy efficiency in the commercial office space, are not a factor.
- Further in the lease sector, tenants may be responsible for their own electricity use, but the building owner usually supplies ventilation, heating, and cooling. These costs are built into leases in ways that can make it advantageous for the owner to make efficiency improvements and may represent a good investment. Here again, split incentives may not be a barrier to energy efficiency.
- As of 2002, the top 25 commercial property owners owned about 525 million square feet of property. This represents approximately 17 percent of all leased space.
- The top 50 property managers manage about five billion square feet. This is roughly half of U.S. commercial office lease space. This means that there is a significant level of concentration of ownership and management in the lease space office segment and that one can deal with a relatively few players and address energy efficiency for large amounts of space.
- The next few years may be a good time to target owners and to get in front of the next wave of new building construction. The construction of office space is cyclical and tends to lag the economy. There is currently a large inventory of space available. If history repeats itself, construction will slow until there is need for additional space, a period that may extend from five to seven years. During this period, developers and property owners will be anticipating their next steps. *Because of this “hiatus” it may be possible to get the attention of owners and building professionals.*
- A high percentage of the quality office space is now located in suburban areas. In the short-term, it appears that there is a movement to downtown office space. However, this may be a reflection of the shakeout of the “dot.com” era in which the more stable and older businesses were located in downtowns and the more volatile dot.com businesses were located in the suburbs.
- Lighting accounts for 30 percent of the energy use in offices, space heating 25 percent, and office equipment 16 percent. Cooling and ventilation account for nine and five percent respectively. Commercial building efficiency programs tend to target electric air conditioning systems while space heating, especially gas and oil space heating, tends to receive scant attention.
- Electronic ballasts are present in 408,000 buildings in this market indicating the presence of at least some efficient lighting in 58 percent of structures.
- Package units are the most common heating source being present in just under 50 percent of the buildings. Furnaces, individual space heaters, and boilers collectively have a larger share of the market. Many gas utilities have complained that there has been inadequate attention to developing new energy efficient gas technologies including space heating technologies. *This may be an area that needs attention both because of short-term supply constraints for natural gas and the long-term outlook.*

- Much of the current approach to developers of buildings is based on the life cycle cost of buildings. There is ample evidence that owners want good buildings and that there are significant non-energy benefits from energy efficiency technologies that could be used to sell efficiency. This is an area that is little explored.

In our analysis, we did not have the resources and data to adequately characterize the ownership and management of owner occupied buildings. This is an area that needs attention because of the number of owner occupied buildings. Owner occupied buildings are 62 percent of the overall office market. As many as half may have fewer than 5,000 square feet and as a result they typically have different characteristics than many of the buildings in the lease segment.

Based on this analysis, large commercial lease operators are an important target. These owners have more than 100 million square feet of office space under development annually. A relatively small number of owners influence a large amount of new space making this group an important target. These owners are best addressed at the national and regional levels. Local entities and utilities are likely to have less influence with this group. *This argues for a national level strategy to address this group. The Energy Star and green buildings programs are currently partially addressing this part of the office market.*

While there are many large owners who occupy their own buildings, the owner occupied segment tends to be more regional and local. This is because many smaller businesses may own their own building. *Effective science based strategies are needed to address smaller local owners, developers, and contractors who are constructing and operating buildings.* Research is needed to better characterize this market and to develop appropriate strategies. *DOE, EPA, national organizations such as CEE, and regional market transformation organizations, public benefits programs and utilities can play an important role in developing strategies to meet the needs of this group.*

In terms of technologies, there is evidence that efficient lighting is already penetrating the sub-market. Space heating is an important percentage of overall energy consumption. Because of the relatively small size of many buildings in the market and the importance of gas heating, efficient space heating technologies may be one of the more important needs of this market.

Retail and service sub-market summary

- Retail and service establishments are physically housed in three contexts: multi-use buildings and standalone structures in central business districts, stores in strip malls, and stores in enclosed malls. The context influences the energy use technologies located in these buildings.
- Establishments in strip malls account for just under one-quarter (23 percent) of retail space, establishments in enclosed malls approximately 14 percent, and the remainder, 63 percent, are in multiuse or standalone buildings.
- The ranks of small retailers are thinning under the competitive pressures provided by larger retailers. This is changing the face of retail and may change the demand for retail space.

- Large national chains predominate in enclosed malls. National and regional chains are also frequently found in strip malls. National chains that utilize the big box format such as Circuit City, Best Buy, Wal-Mart and Target are often found in strip malls or in standalone locations adjacent to enclosed malls or strip malls.
- The large chains dominate the “mall market” with large stores. The design and implementation of these stores is based on standard architectural design and maintained by “image architects” that work for the chains.
- To influence the energy efficiency of these buildings, one needs to address the vice presidents for construction for the large chains and the image architects at a national or regional level. If these changes have cost implications, the persons responsible for financing may need to be addressed as well. Some chains are already quite conscious of energy costs. Some are equally concerned about “comfort” and “display aesthetics” as part of the shopping experience. Comfort and display aesthetics are both closely tied to energy use. Comfort and energy efficiency are close allies. Display aesthetics, which may involve specialized lighting, may lead to increases in energy use. *In order to influence energy use in this market, it may be important to focus on aesthetics and comfort rather than on cost.*
- The average size of large retail stores has increased from about 123,000 square feet in existing (older) buildings to 140,000 square feet in new stores. As some retail stores expand in size, there will be an increasing need to focus on reducing the energy usage associated with larger buildings.
- Renovations follow a prescribed pattern as well as reflect a long-term view that most retailers have regarding capital investments such as remodeling or new construction. For example, the average national retail store is remodeled every seven years. However, some types of stores – such as the big-box stores and home centers-- are remodeled about every six years. *This suggests that there is a window of opportunity to influence these decisions but only if the decision-makers are approached early in the planning process.*
- Space heating is the predominant end-use intensity in this sub-market. Space cooling is about a sixth of the intensity of space heating and one-quarter of that of lighting. Other uses are relatively small.
- Local retailers contract with developers to develop new buildings. We need to know much more about new building construction for independent retailers.

Lodging sub-market summary

- The lodging segment is one of the smallest commercial building markets, accounting for approximately 175,000 buildings and four billion square feet of commercial floor space. This equates to 53,000 properties with more than 4.2 million rooms.
- The top 40 lodging firms and their affiliates own three million rooms or about 70 percent of the market.
- In 2002, the Cendant Corporation was the largest lodging firm, accounting for 12 percent of the total U.S. lodging market, and owned or franchised 17 percent of all hotel

rooms among the top 40 domestic hotel companies. Other large lodging firms included Six Continents, Marriott International, Choice, Hilton, and Best Western.

- By one count, the top 10 lodging firms own 58 brands. For example, Choice Hotels owns eight brands: Clarion, Comfort Suites, Comfort Inn, Quality, EconoLodge, Rodeway Inns, Main Stay Suites, and Sleep Inn. The reason for multiple brands is to provide service across a range of price points.
- There are more than 14,000 independently operated motels with 1.1 million rooms.
- Hotels and motels can be divided into business and leisure hotels. The leisure segment has about \$135 billion in revenues annually and the business segment about \$95 billion. Rooms and food account for about two-thirds of the revenue in the business sector. Food, entertainment, and shopping account for 69 percent of the revenue in the leisure sector. Clearly, there are significant energy differences in the operations of these two sectors.
- Although large lodging firms dominate the industry, there is a high degree of franchising in this industry and properties with chain identification are often independently owned and operated. Smaller firms run the franchise operations.
- Franchisees and independents typically serve the business or traveler segment rather than the leisure segment. Further, franchisees and independent operators typically serve the lower end of the market owning 43 percent of the “budget” properties and 19 percent of the “economy” properties.
 - 85 percent of properties in the United States have less than 150 rooms.
 - 52 percent of properties have less than 75 rooms.
 - 45 percent of properties charge less than \$60 a night.
 - The average net profit for a typical 100-room hotel, with a \$79 average room rate, a \$5 million loan, a 60 percent occupancy rate, and annual revenues of \$1.9 million is \$180,000.

The extended-stay category, for example, Marriott’s Residence Inn, is the fastest growing segment, with room supply increasing by nearly 10 percent last year.

Given high operating costs and thin margins, energy expenses represent a potential opportunity for lodging establishments to trim costs. Energy is four to five percent of revenues. During economic downturns, hotel operators are concentrating on strategies to reduce energy costs. According to Ernst & Young, operating costs can be reduced from 15 to 20 percent annually through energy efficiency measures.

The patterns of ownership and franchising in this sub-market indicate a high degree of concentration of decision-making. A relatively small number of firms own or exert control or influence over a very high percentage of rooms. In order to promote energy efficiency for a large number of rooms, one needs only to address a relatively small audience.

At this point, we do not know to what extent energy efficiency issues are being addressed. Some lodging firms may be more aggressive in this regard than others. There may also be differences in how large lodging firms perceive and address energy effi-

ciency across their brands. Energy efficiency may be more important to low cost brands while aesthetics and comfort may be more important for high-end brands.

Food sales and services sub-market summary

This is a very broad sub-market encompassing food processing, wholesaling, services, and sales/retailing. This report focuses on food services and food sales with some attention to wholesaling. Processing involves extensive energy use, but activities in this sub-market may be more appropriate for a discussion of the agricultural sector.

This focus on food services is important because chains account for a major portion of the food sales and services sub-market. It was also necessitated because data and information on independent food sales and services are somewhat limited. *An analysis of independent food sales and services sub-markets will require further exploration at another time.*

The theme that emerges in the food sales and services sub-market is concentration, concentration, and concentration. This is because the food sales and services sub-market is dominated by a relatively few large firms. This has two important implications for improving energy efficiency.

- Energy efficiency efforts in the food sales and services sub-market will require broad national and regional efforts directed at regional and national companies that tend to dominate this sub-market.
- Attempts to address energy efficiency issues in the food sales and services sub-market at the local level are likely to meet with limited success unless the targets of such energy efficiency efforts are independent local operators. Local independent operators are important and represent a modest fraction of the total food sales and service. Their issues need to be addressed. In order to do this, we need to know more about local independent operators and their operations.

High levels of concentration are found in all parts of this sub-market.

- The top 50 processing companies have annual sales of \$280 billion and dominate the beverage, meat processing, food processing, cereal, soup, and household product markets.
- Among broad line merchant wholesalers, the top four firms account for 47 percent of sales. In order to compete against manufacturer wholesale operations that deal directly with large grocery chains, broad line merchant wholesalers are branching out into food sales retail operations.
- Institutional distributors have sales of \$52 billion annually. Seventy-seven percent of these sales can be attributed to two distributors.
- There are 858,000 restaurants in the U.S. with total sales of more than \$400 billion. Twenty-five firms who own or franchise restaurant chains account for one-fourth of sales and one eighth of the establishments, slightly more than 100,000 locations. These firms own about 25,000 units and franchisees the remainder. The important

point is that these 25 firms exert substantial control over the operation of more than 100,000 units.

- There are 75 national and regional supermarket chains that account for 71 percent of the \$682 billion in annual grocery sales.
- Fifty convenience store chains account for a little over 40 percent of the convenience stores in the U.S. Many of these units are operated as franchises and are sometimes considered to be independents, but the chains exert significant control over their start-up operations.

A two-pronged strategy is needed to improve energy efficiency in the food sales and services sub-market. One prong of the strategy needs to target the large national chains and franchises. This strategy needs to be developed and embraced by DOE and EPA, the larger national and regional market transformation organizations, and the trade organizations representing the franchises. A second strategy addressing regional and independent local firms may be developed and promoted from the national level but requires partnering and a high degree of involvement with local entities.

The large national and regional firms centrally set the design standards that govern building design and construction and the equipment that they install or cause to be installed. *In order to influence designs and equipment choices, it is necessary to deal with decision-makers and the designers at these levels.*

As was pointed out above, the number of decision-makers is significantly less than the number of establishments. Some well-focused efforts have the potential for significantly influencing energy efficiency for a large number of buildings. It should also be noted that firms in the food sales and services sub-market work with thin margins, and changes in energy costs can be an important factor in decision-making.

The rest of the news is that chains are quite conscious of their image and connect image to revenues. Changes that are perceived to adversely affect image and revenues are not likely to be adopted. *Thus, strategies targeting these firms are more likely to be successful if they address efficiency within the context of image rather than just promoting energy efficiency.*

Local and independent operations are a significant part of the market. Whereas the large national and regional chains and firms may require a national effort, local independent firms are best approached through local entities. The operation of independent businesses across local markets is likely to be quite similar. Local energy efficiency programs may be resource constrained in their ability to develop sophisticated approaches to the market. Local entities such as utilities, third parties, and public benefit programs might benefit significantly by partnering at the regional and/or national level to develop tools for understanding the local markets and developing local program models that can be modified and applied in local settings. *This is an area in which DOE, EPA, CEE, ACEEE, the regional transformation organizations, state energy offices, and others might become involved.*

There are some additional findings in this chapter. Given that the structure of this sub-market is constantly changing, it is important that energy efficiency organizations are cognizant of trends that will influence how they deal with the market.

- Americans will continue to eat out and the number of meals that are eaten outside of the home will increase. However, we may see changes in the American diet and this may have significant implications for the types, kinds, and locations of restaurants. This may influence energy use and consumption and may present opportunities to build energy efficiency into the new diet or cuisine.
- Secondly, there is a significant increase in takeout meals. This trend is likely to continue and likely to compete with the trend of eating out. Rapid growth in the takeout sector is likely to impact the size, type, and equipment used in food preparation facilities. Take-out facilities may be mainly oriented to food preparation and display with little or no in-house seating. Some pizza operations have already separated their takeout/home delivery operations from their eat-in operations.
- E-commerce is also likely to influence food sales. Increases in home food delivery services may reduce the need for stores or result in changes to stores. Presently there are two models for food delivery services, a warehouse model and a local store model. In the former, grocery orders are delivered from central warehouses. In the latter model, grocery deliveries are serviced from local stores. The latter model requires less capital and may prove more viable in the long term. This could significantly influence the organization of local supermarkets

As we have reviewed the equipment and energy use information in this sub-market we have noted several things.

- First, daylighting is not yet much of a factor in food services and sales operations. However, some national level firms are beginning to pay attention. Potentially it can be an important way to achieve energy reductions, but to achieve its potential it will need to be implemented wisely. There is evidence that daylighting has benefits beyond saving energy, for example, causing sales at store locations to be 40 percent greater than at comparable locations without daylighting.
- Secondly, cooking is the most intense energy use in the food sales area. Potentially, this is an area ripe for energy savings. Changing cooking methods can influence labor costs, food quality, and safety. At present, there is a fair amount of research into cooking methods. *DOE may want to examine how it might encourage and/or promote these methods to reduce energy use.*
- Refrigeration is a significant part of the operations in the food sales arena. Open cases contribute significantly to energy use and appear to be widely used in new and large stores. More efficient refrigeration units would have a significant impact in this area. Use of waste heat from refrigerators for hot water or heating also has potential. Reducing the need for refrigeration by using alternative food processing and preservation methods also presents an opportunity for dealing with energy use in this arena.
- This report is focused on commercial new construction, but there is more than ample evidence that energy is poorly used in existing food sales and services establishments. Understanding why this is the case and what can be done about it may lead to significant improvements.
- Before leaving this area, we should point out that there is significant potential for changes in food preparation and eating habits. The American diet is increasingly

coming under attack by health specialists and officials. Some supermarket operators see the necessity and potential in promoting healthy food alternatives. This also has implications for the organization of supermarkets and the potential to increase or decrease energy use.

Healthcare sub-market summary

- There are more than 125,000 buildings dedicated to inpatient and outpatient healthcare services. Roughly 11,000 of these are inpatient facilities and the balance outpatient facilities. Inpatient facilities occupy slightly less than two billion square feet while outpatient facilities occupy about one billion square feet.
- The energy-use profiles of inpatient and outpatient services are very different. Buildings used for inpatient service have the second highest energy use intensity among buildings in the various commercial sub-markets, 230 kBtus per square foot annually. Buildings used for outpatient services have energy intensities that are smaller than those for office buildings, about 80 kBtus per square foot annually.
- The healthcare facilities industry includes a range of organizations and ownership profiles. The main sectors are acute care hospitals, rehabilitation hospitals, psychiatric hospitals, nursing homes, assisted living facilities, and home healthcare services.
- The healthcare industry is undergoing consolidation resulting in a reduction in the number of acute care facilities and a shift to smaller more specialized locations for various treatments.
- New construction in healthcare has been constrained by industry consolidation and cost-containment. The sub-market will continue to grow due to the aging population and increasing need for specialized medical services. Healthcare continues to be one of the fastest growing industries in the United States. How that growth will translate into buildings and energy use is less clear. The residential care segment may be one of the most dynamic parts of this market.
- The types of equipment installed in these settings vary considerably by the type of building. The larger systems are installed in larger facilities, including acute care hospitals and institutions. However, the growth of smaller off-site healthcare centers, such as clinics and doctors' offices, which rely on smaller packaged equipment installations, may fundamentally change the type of equipment being used in this sub-market.

Warehousing sub-market summary

- The warehousing sub-market includes industrial warehousing and storage for goods. Many establishments in this sub-market operate networks with physical facilities, labor forces, and equipment spread over extensive geographic areas.
- The 50 largest firms involved with warehousing manage 810.7 million square feet of space—an increase of 73.2 million square feet from 2001. The top 10 companies account for slightly more than half (51.6 percent) of the warehouse space owned by the top 50 companies.

- A majority of warehouse companies (60 percent) report an increase in the amount of warehouse and distribution center (DC) space they manage compared to 2001 levels.
- There are four types of ownership structures within the warehousing segment:
 - Public – accounting for 10 percent of the market
 - Private – accounting for 63 percent of the market
 - Public/Contract – accounting for 15 percent of the market
 - Contract – representing 12 percent of the market
- Public warehouses are open to the public for use.
- Large retail, manufacturers, and shipping companies, such as United Parcel Service, Wal-Mart, Home Depot, Lowe's, and General Motors, dominate the privately owned warehouses.
- Contract warehouses lease space to users.
- Electronic commerce and the Internet are redefining how the warehousing industry operates. This industry is increasingly concerned with speeding the transmission of orders, flexibility to meet customer needs, convenience, and building relationships with customers and suppliers.
- The major energy uses in this sub-market are heating, lighting, and refrigeration.
- At least from the size and ownership of the various warehouse sub-markets, it appears that private warehouses may represent the best opportunities for energy efficiency.

Education sub-market summary

- There are more than 300,000 school buildings nationwide.
- Seventy-three percent were built before 1973.
- The one hundred largest school districts serve a very high percentage of all students. It is possible to influence a great deal of building square footage by focusing on these districts.
- Certain parts of the country are currently experiencing a boom in school construction.
- The current budget problems in states and localities may slow school construction.
- School districts tend to use the more traditional architectural model in planning school construction. The process tends to be drawn out. Still, energy efficiency must be incorporated in the early stages of design in order to insure that efficiency needs are met by the budget.
- The architects for schools are often local or regionally based architects, many of whom specialize in school design.
- School districts are sensitive to the long-term maintenance costs of the buildings that they build. As a result, they are open to implementing energy efficiency.
- There is some evidence that the schools now being built are more efficient than offices. In part, this may be due to the sensitivity of schools to long-term operation and

maintenance costs and to the bonding process used to finance construction that may result in more flexibility than the financing approaches used in other parts of the commercial building market.

- There are a number of trends that may influence energy use in schools:
 - Longer school hours
 - Cluster concepts that house students in co-located buildings and that share specialized facilities such as gymnasias, laboratories, cafeterias, and other facilities
 - Year round classes
 - Individualized instruction
 - Smaller classes
 - Virtual education

An articulated and integrated approach to energy efficiency in commercial buildings

Historically DOE's approach to energy efficiency in commercial buildings has been to focus research and development on promising technologies that have the potential to impact demand and energy use. Similarly, utilities and other implementation organizations have focused on available technologies and have attempted to penetrate the various sub-markets with them. By and large, the marketing strategies have been one-to-many efforts that have relied heavily on "broadcast" methods to communicate with target audiences. While these strategies have had some impact, there are more effective ways to communicate with target audiences. In this regard, this study documents several important points.

The commercial building market is a heterogeneous market comprised of a number of sub-markets that can be further segmented. This study makes a substantial contribution in understanding these markets and segments, but much additional work is needed. In particular, it is important to know in which sub-markets and segments and to what extent players may already be addressing efficiency issues and in which sub-markets and segments efficiency may be lagging.

We also know that the sub-markets and segments have different technological needs, different value propositions, and different future prospects. Energy efficiency technologies and programs that are keyed to these needs, propositions, and prospects are likely to be much more successful than broad scale efforts with no specific target in mind.

For both new construction and remodeling and renovation, financing sets the constraints within which developers, owners, and building professionals can act. This has two important implications. The first is that energy efficiency needs to be on the agenda prior to financing so that the first costs of efficiency can be addressed. A second implication is that owners and developers need to understand the value of energy efficiency in terms of value propositions that make sense to them.

Within nearly every sub-market, there are two sets of players, the large national owners and chains and the smaller more local and independent players. The large national players often have standards and guidelines that they use nationwide and relatively small teams of buildings professionals who design, manage, and build buildings for them. Na-

tional leadership and a national level effort are needed to influence these players. The good news is that one may only need to influence a few hundred or fewer players in a given sub-market or segment in order to have a significant impact on energy efficiency in commercial buildings. The other piece of the news is that in order to be really effective in penetrating these markets, it is important to selectively target these players a few at a time and work with small groups and through professional interaction on a one-to-one basis. This is important for understanding energy efficiency needs in order to design future generations of technologies, to deliver technologies that will be adopted, and to facilitate their adoption. Federal agencies such as DOE and national energy efficiency organizations need to partner with each other to accomplish these ends.

The needs of local and independent players must also be addressed. The technologies that are important to them may be somewhat different than for the larger players, and the resources that they have available to them may be more constrained. Within sub-markets and segments, the needs of small players are quite similar. Effective strategies and resources for addressing the efficiency and marketing needs of these players can be developed through the cooperation of state and local governments, local and regional energy efficiency organizations, utilities and Federal agencies. The job of selling and implementing energy efficiency to these players is likely to be most effective if it is based on one-to-one relationships at the local level.

In the end, energy efficiency and conservation will be adopted much more rapidly if two things happen. The first is to articulate the similarities and the differences in technological needs and the structure and organization of sub markets and segments so that technologies and implementation efforts match and meet the needs of the players. The second is to integrate efforts across Federal, state, public, and private organizations focusing on large players with high concentrations of buildings within the sub-markets and a separate integrated effort that targets more local and independent players in those same markets.

Recommendations

Key recommendations from this report are that DOE:

- Develop a plan and commit resources to continuously and systematically update its understanding of the commercial building market, to make greater use of commercially available secondary information to increase DOE's understanding of the commercial building market, and to access secondary information through partnerships and relationships with firms and associations that are already collecting this data.
- Develop a plan and commit resources to continuously and systematically identifying and tracking trends that will influence the construction and use of buildings in the future and systematically incorporate this information into planning efforts. This includes closely tracking emerging efforts to design and build commercial buildings using component methods, the use of high tech materials in buildings, and social and cultural trends that may result in changes to building use patterns and the need for commercial buildings.

- Commit resources to increasing DOE's understanding of the decision makers in the commercial building community and identifying the parameters and value propositions that inform decision-making across situations.
- Initiate, support, and/or participate in sub-market specific events such as workshops, strategy forums, and conferences that involve the largest players and their trade associations in each of the major sub-markets to increase DOE's understanding of relevant issues in the major sub-markets, the long-term direction of the sub-markets, sub-market technology needs, changing decision-making structures, and key decision criteria.
- Commit to planning, developing, and implementing a national energy efficiency strategy that:
 - Targets large national firms that franchise or have large property holdings in the major commercial sub-markets through one-to-one national level marketing efforts.
 - Targets smaller regional and local players by:
- Partnering and coordinating with other government agencies, regional and local energy efficiency organizations, trade associations and others to develop science based implementation strategies, programs, and materials that can be adapted by energy efficiency, environmental, and or utility organizations at the state regional and local levels.
- Developing and implementing a strategy to recruit regional and local organizations to implement the science based strategies.
- Conduct market research to assess which actors in national markets are incorporating energy efficiency into new and redeveloped buildings and which developers continue to use traditional practices. The purpose of this assessment is to determine which actors are already incorporating energy efficiency into their buildings and which continue traditional practice. This information is useful for identifying technology needs and implementing direct one-to-one marketing strategies. We recommend the assessments focus on:
 - The top 25 to 50 national and regional office developers.
 - The top 100 large national and regional retailers and the top national developers of retail property.
 - The top 50 national and regional fast food chains. The assessment should also address how decisions are made for both corporate and franchisee operations. We also recommend that DOE monitor and perhaps participate in efforts to improve the energy efficiency of kitchens in fast food chains and restaurants. The DOE may want to partner with trade associations, hospitality schools, and utilities such as PG&E that are already working in this arena.
 - The top 75 major national and regional grocery chains.
 - The top 40 lodging firms and their lodging brands. The assessment should identify the decision makers, how decisions are made for corporate and franchisee operations, and how brand value propositions influence the adoption of energy effi-

- ciency. Studies have previously been completed that have identified technology packages.
- The major national for-profit and the major not-for-profit hospitals and healthcare organizations.
 - The top 100 school districts and research universities.
 - Partner with government agencies such as the EPA, other relevant federal agencies, and national and regional market transformation organizations to identify and address technology and implementation needs and develop scientifically based one-to-one marketing strategies that promote more efficient technologies and designs that:
 - Target the top 25 to 50 office developers.
 - Target large national retailers and their image architects and engineering firms. Large national developers that lease space to these retailers should also be targeted.
 - Target the top 50 national fast-food chains, their image architects, engineering firms and franchisees.
 - Target the top 75 national grocery store chains or their franchisees. The strategies might include a special technology focus on refrigeration end-uses.
 - Target the 40 national lodging firms, their brands, their image architects, engineering firms, and franchisees. The strategies should take cognizance of and incorporate the value propositions that are part of the branding for the chains.
 - Target the large national organizations, developers, hospitality organizations, and others who are developing housing for the seniors market.
 - Promote more efficient technologies and designs among the large national for-profit hospital chains and the large not-for-profit chains as well. When dealing with the not-for-profit chains, that are frequently regional, we recommend that the DOE partner with regional organizations.
 - Target the top 100 school districts and the large research universities.
 - Partner with other government and national transformation organizations and work with state energy offices, regional and local energy efficiency organizations to develop scientifically based marketing strategies, technology packages, and other resources that can be used by regional and local implementation organizations to foster energy efficiency:
 - Among the large number of smaller office building owners and managers.
 - Among small independent retailers. Such strategies should also target local developers, distributors, and contractors.
 - Among small independent restaurants. Such strategies might include working with franchisees of national fast-food chains that have a high degree of autonomy and should also target local developers, distributors, and contractors.
 - Among regional and local restaurant franchises. Such strategies might include working with local developers, distributors, and contractors.
 - In independent community hospitals. Such strategies should also target local developers, distributors, and contractors.

- For small owner run lodging operations or branded operations that have to adhere on minimum standards of operation.
- In smaller local school districts and colleges and universities other than research and specialize institutions.

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Chapter 1 Introduction

The Department of Energy, Office of Building Technology, State and Community Programs, contracted with Innovologie, LLC, to characterize the commercial new construction market in order to better understand the needs and operation of this market, to more effectively identify technologies needed by the market, and to suggest ways to improve the effectiveness with which technologies are diffused to it. The commercial building market includes but is not limited to buildings used for offices, retail, healthcare, hospitality, public assembly, education, and worship. While the focus is the new construction market, information about the remodeling and renovation market has been included as well because, depending on the circumstances, it may be difficult to distinguish between these two markets.

The goals of this project are to identify:

- The types and kinds of new commercial structures that are being built and will be built in the short and long term
- The levels of commercial new construction activity by locale and by types and kinds of structures
- The number and size of players, including developers, owners, architecture and engineering firms, especially the major national and regional players
- The interactions among the players including patterns of association and information exchange
- The segments within the market where the players share similar patterns of decision-making, capital use, or technology needs
- The process by which new commercial building construction is completed and the forces at work within the process that influence the energy efficiency of buildings
- The individuals and firms within the market who are the leaders and who influence trends
- The forces at work that are changing the way players relate to one another and the way they make decisions
- The strategies that might accelerate and increase the acceptance of energy efficient technologies and whole building design concepts

Approach

As originally envisioned, the project was to complete a review of information from secondary sources and a set of interviews with key players in the market. However, because materials from secondary sources were much more extensive than was originally thought, it seemed prudent to use the available resources to analyze the secondary source material and postpone the interviews this work was completed.

This report is based on several kinds of materials. Some of the basic information about building types, sizes, and energy uses was drawn from the 1999 Commercial Building

Energy Consumption Survey (CBECS) completed by the Energy Information Administration (EIA), Department of Energy. Some of this information was drawn from published tables and some was developed from analyses of the CBECS public use sample. The CBECS survey is currently being updated by EIA.

Much of the information for this study was gathered from the Internet. A great deal of the information comes from surveys and information compiled by trade associations and trade publications. In some instances, private firms collect information and produce reports for an industry. These reports are produced annually or at some longer interval. Many of these sources of information have been available in printed format for a number of years but have not been widely known or available outside of the disciplines for which they were produced. Within the last three to five years this information has been placed on the Internet, which, with current search engine technology, makes it easy to locate and retrieve. Table 1 presents a selection of the sources used to this document.

Table 1 Sources of statistics from the Internet

Source	Type of data
National Real-estate Investor	Office statistics
Shopping Center World	Retail statistics
American Senior Housing Association	Housing for seniors
SIOR Comparative Statistics of Industrial and Office Real Estate Markets	Office statistics
International Council of Shopping Centers, National Research Bureau Shopping Center Database and Statistical Model	Shopping center statistics
Chain Store Age	Retail statistics
Chain Store Age/Leo J. Shapiro & Associates	Statistics about stores
BizStats.com	Business statistics
Census of Manufacturers	Food sales and service data
Census of Retail Trade	Food sales and service data
Census of Wholesale Trade	Food sales and service data
Census of Accommodation and Food Services	Food sales and service data
Prepared Foods Magazine	Food sales and service data
Technomic, Inc.	Data on restaurant chains
Progressive Grocer	Supermarket statistics
Food Marketing Industry Speaks 1992–2002	Supermarket statistics
National Association of Convenience Stores	Convenience store statistics
American Hotel and Lodging Association	Lodging statistics

Source	Type of data
Smith Travel Research	Lodging Statistics
AHA Hospital Statistics	Hospital statistics
Provider	Assisted living statistics
Health Industry Market Intelligence Database	Health statistics
Reed Business Information, a Division of Reed Elsevier Inc., 2002	Warehouse statistics
U.S. Department of Education, National Center for Education Statistics, Common Core of Data Survey	Educational statistics

There are several points to be made about this information. Many of the databases from these sources are based on surveys conducted by trade associations and rely on voluntary response and self-reported information. Not all firms respond to the surveys. Based on our experience in working with this information, it appears that the largest firms tend to respond while smaller firms do not respond or are not polled. We also point out that in some instances it may be to the respondent's advantage to over or under report information or to not report certain kinds of information. For the most part, the data from these sources seem relatively complete.

A second important point is that the information is collected for use by the trade association and its members. It tends to focus on issues of importance to them to the exclusion of other concerns. Thus, it does not always contain the level of detail about buildings or decision-making that we might like.

A third point is that the data reported on the Internet is a selected subset of the available information. Much more information is collected than is reported publicly in the publications and by the trade associations. Thus, there is potential to learn more from the data that has already been collected than is evident on the Internet.

We recommend that DOE examine the potential for using this information. This information may be available for purchase and/or DOE may be able to partner with these publications and trade associations to produce new information from the existing data. We believe that this is a rich resource that might allow DOE to track trends more closely and to develop a more in-depth understanding of these markets.

Finally, we examined a great deal of information from published reports and documents. For example, the futures chapter is based on a number of books and publications. This is true of the decision-making chapter as well. There is much more data and information that could be accessed with additional resources. We believe that this is a significant start in developing a more comprehensive understanding of the new construction market.

The organization and content of this report

Our original plan for this report was to do an overview of the buildings market and then to develop materials about each of several commercial building sub-markets. As we began to implement this plan we realized that most of the information that we had was historical. There was a certain temptation to project the future of commercial buildings based on our current understanding of buildings. However, as we examined these markets, we were reminded that there are many forces for change in our society that determine what buildings are built, where they are built, how the buildings are used once they are built, and how frequently they may have to be renovated or modernized.

If, for example, the Internet changes how we shop and how we meet for business, then it is useful to speculate as to how that might change the retail, lodging, and warehousing industries. If we travel less for business purposes because of web conferencing, perhaps the travel industry will focus more on leisure travel. If companies are using electronic networks to organize and improve the flow of goods, certain types of warehouses may become obsolete and others may take on new functions. Thus, rather than surveying the sub-markets and then discussing the future, it seemed better to start by examining the trends for the future so the trends could inform our examination of the various commercial building sub-markets.

Thus, we start with a chapter about the future that relies heavily on the work of futurists. Our purpose is not to project the future but to examine scenarios that highlight a range of options for what the future might hold. The intention is to provide a counterpoint to linear projections of what the future of buildings might be.

One of the main purposes of this document is to examine decision-making. Traditionally we have tended to think of the architect as the center of decision-making about new construction. In fact, there are numerous decision makers: the capital provider, the owner of the building, the user(s) of the building, the design team, the developer, and the contractor. A careful examination suggests that key decision makers are situation specific. In Chapter 3, we try to identify the situations and the factors that determine who makes decisions and the criteria that are used to make decisions across the range of situations.

Chapter 4 is an overview of what we know about the physical characteristics of the building market as a whole, the relative size of various submarkets, and an overview of what we know about energy use in buildings. Based on a look at energy intensity and the numbers of buildings in the various sub-markets, we selected seven sub-markets to examine in the chapters that follow.

As noted previously, one of the foci of this study is to determine who the players are and who makes decisions in the sub-markets. For each of the submarkets, we examine information about the number and characteristics of the buildings in the market and then we turn to a discussion of who the players may be. We also examine the energy technologies being used in the sector and the extent to which efficient technologies may have penetrated the market.

In the office sector, Chapter 5, we examine the differences between owner/users and owners who lease buildings. What emerges is a pattern that carries through several of the sub-markets. There are large national firms who own and manage large amounts of

property that lease that property to others and a much larger number of smaller owners who own and use their own property. Who controls the space has important implications for the strategies that are needed to promote energy efficiency.

In Chapter 6 on the retail sub-market, we examine three groups of players. Large developer/owners who lease space, large retailers who lease space, and retailers who own their own space. Large retailers who lease space have a great deal of control over the design and construction of buildings they lease. They are an important group of players who are probably best addressed at the national or regional level.

The food sales and service sector is quite complicated. In discussing this sector (Chapter 7), the food production and processing sectors are touched upon only briefly because they tend to be more industrial than commercial. There is a discussion of food wholesaling. Wholesalers are trending toward greater involvement in retail food sales as a response to the fact that the larger grocery firms are increasingly dealing directly with the processors and wholesalers.

The food sales and service chapter also examines consumer trends such as “takeout” meals and eating out and the impact these trends are having on food sales and buildings as well. There is a discussion of food sales from the perspective of grocery firms and convenience stores. A key trend is the growth of “supercenters” and wholesale firms such as Costco and the struggles of more traditional grocery firms to respond to these well capitalized and aggressive retailers. Supercenters and consumer warehouses are reshaping the landscape of food sales.

As discussed in Chapter 8, the lodging sector is interesting for several reasons. There is a high degree of concentration in this sector that takes the form of ownership, branding, and franchising. This has a variety of implications for the strategies for improving energy efficiency. This market is also changing with significant growth expected in the leisure side of the market. The leisure market has very different energy use characteristics than the travel market.

We read about healthcare on a daily basis in our newspapers. We sometimes deal with the healthcare system more than we would like. In Chapter 9 on healthcare, we see that how and where healthcare is delivered in the future is changing under pressure from health maintenance and preferred provider organizations that are trying to contain and reduce costs and from very significant changes in the scale and requirements of medical technology and drug treatments. The locus of medicine in the future is likely to be offices, clinics, or homes. The decline in the number of large hospitals will continue and the functions of hospitals will change. The outpatient sector of the healthcare system will grow with the demand for senior housing. Larger companies that are better capitalized and able to deliver better services are reshaping that part of the sector, which has largely been the province of small independent operators.

Warehousing is also changing. Traditionally, warehouses were designed for the storage of goods in transit. Just-in-time manufacturing and business philosophies that stress attention to core business practices are causing the warehousing sector to change its function from traditional warehousing to logistics. It is increasingly difficult to distinguish the end of the assembly line and the beginning of the transportation function. This has implications for warehouses of the future.

Finally, in Chapter 11 we examine the education sub-market. The education market includes K-12 schools and colleges and universities. It is fairly clear that computers and the Internet are changing the way K-12 and college and university education is delivered. The most substantial changes may occur in the post-secondary market where for-profit education, education delivered by employers, and on-line education may have significant impacts.

What will the future of commercial buildings be? Who will decide?

Chapter 2 Trends That Will Influence Buildings in the Future

Introduction

Commercial buildings are continuously changing and evolving to meet the needs of their users. The structure, operation, and use of buildings in the past are in some ways different than today and in other ways very much the same. The commercial buildings of the next several decades will continue to evolve to meet the changing needs of their users. Some functions will remain the same, some will disappear, and new functions will appear.

When I think about changes in commercial buildings, I think about how my own experiences with office settings have changed over the years. It was just 25 years ago, that I moved from a typewriter to a microcomputer, an Exidy Sorcerer. Few people have even heard of that machine. It was barely capable of doing word processing. Twenty years ago I had a conversation with the information technology people at the institution where I worked who demanded to know of what use a spreadsheet might be, why I should have one of these new fangled Apple III computers, and why I should be wasting precious resources that could be used to maintain a mainframe.

As I write this, I am using a microcomputer that is more powerful than the minicomputers used in 1983. The microcomputer I am using is wirelessly connected to a router that is connected to the Internet. I am writing this document from an office in my home that is more comfortable than any office I have ever had. This document is based heavily on content obtained through the “ether.” It is doubtful that this document could have been produced as little as five years ago without the technology, the World Wide Web, people who post content to the Web, and advanced Internet search technologies. Indeed, much of the source content in this document is now generated in near real time. As we publish this, the Web is morphing from a place where people passively search for content to a place with new tools that allow users to create networks and build communities. This shift has significant implications for the way in which we will conduct commerce in the future. Today’s office is very much different than my office of 25 years ago. Hmm, what will the office will be in 25 years?

Forces at work

As we examined our imagined future, we realized that there will be at least five types of outcomes resulting from change. These general outcomes will appear in all markets but and will feedback into social and cultural systems creating further change. The five general outcomes are:

- Changes in quantity
- Changes in quality
- Changes in form
- Displacement of functions

- Decentralization in some organizations and centralization in other

As we examined trends, we found it useful to think about how specific changes might play out in terms these five outcomes. We also tried to summarize the drivers of change. We identified six major technological arenas that we believe will influence (drive) the ways that commercial buildings will be structured and operate in the next 25 to 50 years. The “drivers” of change are:

- Communications
- Energy
- Transportation/logistics
- Biotechnology/nanotechnology
- Manufacturing
- Materials

Communications

Communications will link information from existing as well as new sources seamlessly through networks connecting users in different markets and market segments. Communications technologies will include wireless technologies such as WIFI and Bluetooth, the Internet and advanced versions of the Internet, and increased interoperability among computers, telephones, household appliances, and office equipment using advanced communication protocols. There are undoubtedly communications technologies that have not yet been conceived that will make WIFI and Bluetooth look long in the tooth.

Buildings of the future will incorporate communications in new and different ways including virtual multimedia connections, Web sites, and networks that will connect sensors, occupants, users, management companies, and even other buildings. The rise in communications will facilitate trends such as teleconferencing, telecommuting, flexible workspaces, and dispersed offices and result in smaller requirements for permanent traditional “Class A” office space.

Communications will facilitate the transportation of goods and services among users and provide an “always on” link to vital information.

Energy

There will be significant changes in the way that energy is generated and used in buildings in the future including shifting usage patterns as a result of new technologies, changes in organizational structure, and new power sources. Micropower, fuel cells, and “off-the-grid” photovoltaics may all alter the way in which buildings are designed and used. For instance, the shift to fuel cells might cause a shift from the use of alternating to direct current for the distribution of electricity within buildings. If fuel cells become a distributed technology there may be an array of voltages to meet specific needs. Traditional power supplies may be displaced, and electric motors with belts and drives with gears may give way to direct current motors or the equivalent.

Using improved communications services, buildings will be better able to manage their energy usage, identify areas of energy loss, and even run diagnostic system checks.

Transportation/logistics

Transportation/logistics refers to those applications that are concerned with delivering goods and services to customers in the future. These include new demands required for the transportation sector, alternative forms of transportation, and changing transit patterns as employee behaviors change.

Transportation improvements will mean that goods and services will come to people, rather than people searching out goods and services. This shift, due to the increase in on-line ordering and improved delivery services, will significantly impact the way that consumers shop, select, and receive a full range of products. This shift will have the most dramatic impacts on the retail and food segments, as customers come to expect clothing, groceries, and meals to come to their door.

Biotechnology/nanotechnology

Nanotechnology has been described as the manufacturing technology of the 21st century. This trend will have a profound impact making all types of technologies much more accessible to users within the commercial building segment.

Nanotechnologies may result in new materials for solar cells that can be incorporated into building materials, more efficient computer displays, and nanoscale lasers, sensors, and computer chips that have wide potential for application in electronics.² Moreover, nanotechnologies can be operated using alternative energy sources, such as solar power, representing dramatic cost savings. Some of the most dramatic applications of nanotechnology may be in healthcare where miniature robots may be able to continuously monitor health conditions and administer drugs as needed. Biotechnology will significantly reduce the invasiveness of medical procedures.

Other trends that are expected to influence the commercial market include the arrival of nanotubes. These are microscopic carbon threads that can have applications in a variety of technologies including replacing silicon-based chips. They are capable of concentrating the transmission of electronics at a lower voltage than existing alternatives, which could lead to an entirely new generation of bright, thin, efficient screens and monitors.³

Manufacturing

Mass customization and the rise of “portable factories” will significantly shorten the time it takes to produce goods and alter the ways that goods are produced and delivered to consumers. Portable factories can be disassembled, transported to another location, and then reassembled cost-effectively. This will allow companies to switch their manufac-

² Chuck Lanatti, “Nanotech’s First Block Busters,” *Technology Review*, March 2004, pp. 46-52.

³ Popcorn, Faith & Hanft, A. *Dictionary of the Future-The words, terms and trends that define the way we’ll live, work, and talk*, New York: Hyperion, 2001, p. 372.

turing to locations where labor costs are cheaper, the exchange rate is better, and/or the taxation is more favorable.⁴

Mass customization uses communication to link customers from ordering to manufacturing to delivery, enabling customers to obtain goods that are specifically designed for them. You can go to some Levi's stores where you are measured and an order is placed for jeans tailored to fit. Land's End allows customers to use the Internet to transmit their measurements to a factory in Mexico where a garment or garments are made and shipped directly to the customer's residence. Computer manufacturers are doing the same thing. This document is being written on a computer that was purchased on-line, assembled in Taiwan, and shipped to the U.S. The only "warehouse" it sat in was one in Indianapolis where it passed through customs. The decision to ship through Indianapolis was undoubtedly a result of identifying the customs point with the least backlog. There were no middle people. In this scenario retail stores are places to see and touch goods, not necessarily to purchase them.

Another important trend in manufacturing is componentiation. Componentiation is the assembly of subcomponents into components and then the assembly of the components into whole products. Automobiles are built this way. Ships are built this way. Airplanes are built this way.

In a recent study for the American Institute of Architects, Steve Kieran and James Timberlake argued that in the not-too-distant future, buildings will be built this way.⁵ In fact, Kieran and Timberlake have built buildings using these techniques. Levin Hall at the University of Pennsylvania is such a building. For that building, they designed an exterior curtain wall fabricated by Permasteelisa of Italy and comprised of an external double-glazed unit, an internal single glazed unit separated by a ventilated cavity served by room vents with an exit at the head of the wall. This curtain wall has only four field joints. The remaining joints are shop built.

Kieran and Timberlake are involved in other projects that use this type of modularized or unitized construction. They are working with Dupont to develop a modular bathroom assembly. They developed a model for the lodging industry that has high quality finishes. They have also designed a similar module for use in university dormitories (Figure 1).⁶ The modules can be used in new construction and remodeling.⁷

⁴ *Ibid.*, p. 375

⁵ Hart, Sarah. "New Ways to Build Better, Faster, Cheaper," *Architectural Record*, January 2002, p. 131.

⁶ Modular Bathroom Proposal 2002, University Housing Bathroom Assembly, Philadelphia: Kieran Timberlake, LLP, 2002.

⁷ Dupont Kieran Timberlake Modular Vanity, Philadelphia: Kieran Timberlake, LLP, 2002.

Kieran and Timberlake argue that in the future components will be assembled in factories and then shipped to the site. Figure 2 shows a modular penthouse being lifted into place atop a London building. The reader might want to consider the possibility that units like this might be constructed outside the U.S., brought to the U.S. on container ships, and installed in coastal cities.

Kieran and Timberlake argue that componentiation will result in mass customized, high quality, but standardized building blocks. It will speed construction and it will result in better buildings. It will fundamentally change the way buildings are designed because design will be done from the core out rather than from the façade to the core. Designs will be done in three dimensions. The era of building from two-dimensional drawing is rapidly waning. Computer-aided design will be linked to computer-aided engineering programs that are linked to computer-aided manufacturing equipment that is highly flexible. There is significant potential in these methods to improve the quality and efficiency of buildings as well as to provide unique designs. This is not your father's pre-fab.⁸

Materials

A variety of new materials are appearing on the horizon that will have far-ranging impacts on both the types of technologies available and the way in which they are used. These materials will affect the ways that buildings are built, operate, communicate, and function in the next century.



Source: Kieran and Timberlake, November 2002

Figure 1 University housing modular bathroom assembly



Source: <http://www.firstpenthouse.co.uk/webcam/photos.htm>

Figure 2 Modular penthouse being lifted into position atop an existing building

⁸ Kellog, Craig. "Again, Architecture Discovers Prefab," *New York Times*, May 29, 2003.

Trends in new materials include the development of catalysis materials, opto-electronic materials, magnetic materials, and “intelligent textiles.” These new types of materials have the potential to reduce emissions, enhance data storage processing and capabilities, replace silicon-based technologies, serve as conduits for electricity, increase the efficiency of construction, and provide opportunities for unique design.

Kieran and Timberlake have shown a structure at the Cooper-Hewitt National Design Museum (Figure 3) that uses a material called “SmartWrap.” SmartWrap is a composite material that integrates conventional functions of the wall such as shelter and insulation. A polyester mixture film (PET) provides protection from the elements and acts as a substrate for other layers. There is a layer of phase change materials that absorb, store, or release heat to moderate temperature. A layer of organic light emitting diodes (OLED) is used to provide lighting and information display. Thin film batteries and thin film silicon cells are used to power the OLED display and to store energy. Conductive ink is used to interconnect the active elements.⁹ Faith Popcorn calls this technology “hypersurface architecture”.¹⁰



Source: Kieran Timberlake, Solo Exhibit Proposal – Cooper-Hewitt, National Design Museum, Smithsonian Institution: SmartWrap: Mass Customizable Print Façade, 2002

Figure 3 Smartwrap building exhibit at Cooper-Hewitt

Drivers summary

The six drivers that we have just discussed will result in a large number of outcomes. Table 2 is an attempt to show how drivers may produce outcomes that will be of importance in the building sector.

⁹ Cooper-Hewitt National Design Museum, “Cooper-Hewitt National Design Museum Premieres Solos Exhibition Series To Showcase Contemporary Architecture and Design — Inaugural Exhibition Solos: SmartWrap Features Building Skin of the Future,” Press Release, August 4, 2003.

¹⁰ Popcorn, F. & Hanft, A. *Dictionary of the Future-The words, terms and trends that define the way we’ll live, work, and talk*, NY: Hyperion, 2001.

Table 2 Building blocks for the future

Market drivers	Outcomes				
	Changes in quantity	Changes in quality	Changes in form	Displacement of traditional functions	Centralized to distributed
Communications	Cell phones, PDAs, personal appliances, etc.	Analog to digital	Wireless technologies	Storage warehousing to pass through value added logistics	Localized communication and decision-making
Energy	Alternative energy sources	Reliable and more efficient solar	Hydrogen	Oil and gas pipeline delivery to on-site production and back	Fuel cells, micro-power, photovoltaic walls
Transportation/logistics	Fuel cell vehicles, on-line purchasing, direct delivery	Improved mass transit	Magnetic levitation	Commuting/delivery services to telecommuting, virtual conferencing, etc.	Neighborhood delivery centers, lockable delivery boxes
Biotechnology/nanotechnology	Rapid penetration of health and manufacturing sectors	Nanomachines for continuous medical diagnosis	Self-changing/self-healing machines	Centralized to decentralized manufacturing, Pharmacies to customized medical delivery	Tiny machines injected into human bodies/cars, etc
Manufacturing	Shift from large to small manufacturing sites	Mass customization	Flexible manufacturing machines	Traditional manufacturing to portable, computer driven, flexible manufacturing	Portable factories
Materials	Nanotubes, polymers	Stronger, lighter, more durable materials, display coatings	Designer materials and designer drugs	Traditional design-build to componentiation and inside-out design	Integrated components allowing off-site construction

The “office” of the future

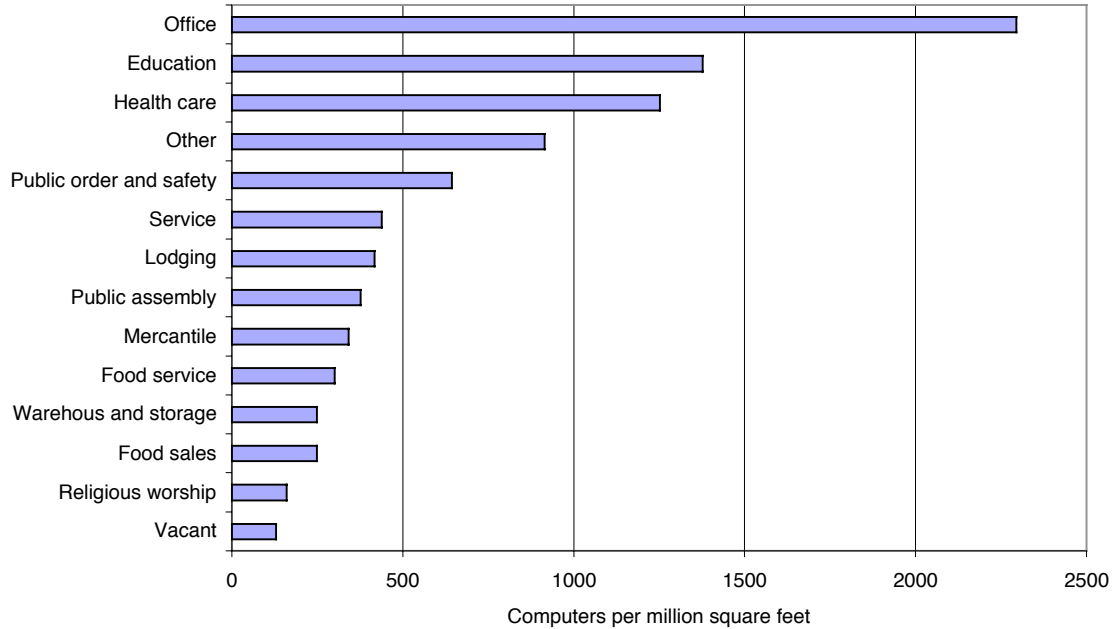
The commercial office will change its face as it adapts to an increasingly mobile, flexible, and interchangeable workforce in the 21st century. The rise of computers, the acceptance of alternative working arrangements such as telecommuting and flextime, and the proliferation of wireless and Internet capabilities have fundamentally changed the ways in which office workers communicate with each other.

While many still work in centralized locations, there has been a growing trend toward working in alternate locations such as satellite offices or at home. Moreover, the proliferation of computers and networks has interconnected diverse workgroups in ways that were never considered just a quarter of a century ago.

Increased use of computers means that commercial office space must offer more flexible and integrated network configurations. These changing patterns also directly affect the ways that energy is used in relation to the workforce, with an increased interest in occupancy sensors, zoned heating and cooling, and improved lighting to better meet the needs of a mobile workforce.

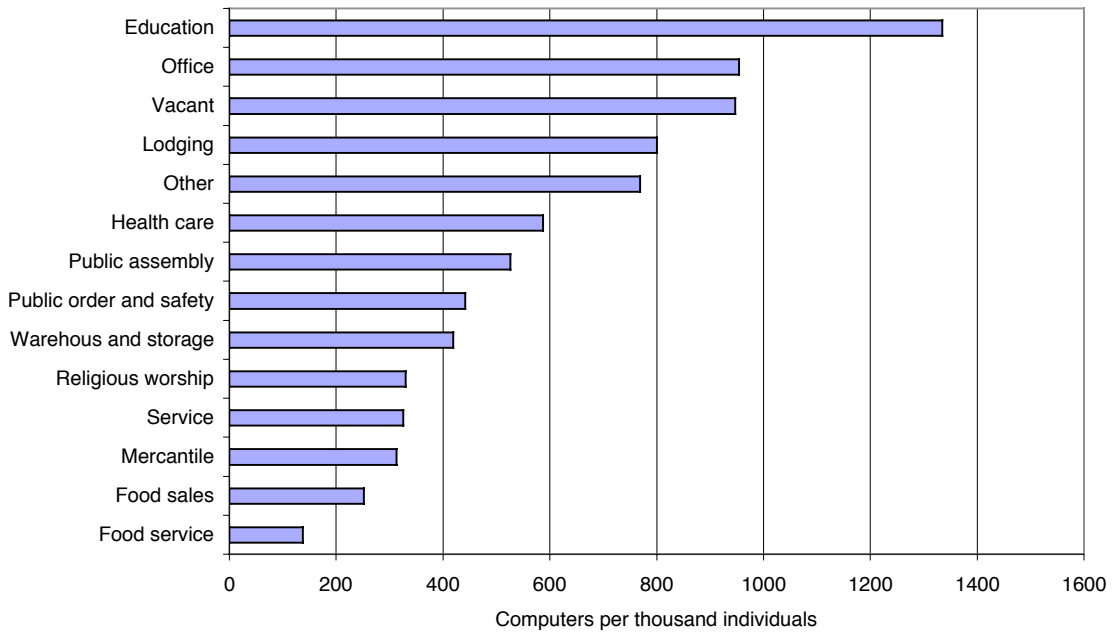
Increased installation of computers and electronics

There has been a steady increase in installations of computer equipment throughout the commercial sector over the past decade. In 1999, the Commercial Buildings Energy Consumption Survey (CBECS) estimated that there were 58 million personal computers installed in the commercial segment. This was an increase of 15 million or 35 percent from 1995. In 1999 there was an average of 707 computers per thousand employees in commercial buildings. There were 2,295 computers per million square feet in the office sector (Figure 4). The health care and education sub-markets had substantial concentrations per million square feet as well. On a per capita basis, the education sub-market had the highest ratio of computers 1.3 per person (Figure 5). The office sector had nearly a computer per person while eight of ten individuals in the lodging sector had computers.



Source: EIA, *Computers and Photocopiers in Commercial Buildings* EIA, 1999.

Figure 4 Computers per million square feet by office submarket



Source: EIA, *Computers and Photocopiers in Commercial Buildings* EIA, 1999.

Figure 5 Computers per million square feet by office submarket

The Internet has fundamentally changed the way Americans work and play with a profound impact within the commercial office segment.

“Whether you sell stock or sell suits, the Internet has changed the world,” says Richard A. Grasso, chairman of the New York Stock Exchange, and he couldn’t be more on the money. “We view the growth of the Internet and e-commerce as a global megatrend,” says Merrill Lynch, “along the lines of the printing press, the telephone, the computer, and electricity.”¹¹

What’s clear is that, whether we like it or not, the Internet is an ever growing part of our lives and there is no turning back. “The Internet is just 20% invented,” says cyber pioneer Jake Winebaum. “The last 80% is happening now.”¹²

Several leading futurists predict that the Internet will change commercial offices in other ways:¹³

- By 2010, most of the United States will be “wired” for high-speed data access.
- Internet-based operations will require more sophisticated, knowledgeable workers.
- Technically trained people will be in short supply for the next 15 years, as virtually every business in the world competes for their services.
- High-speed communication will allow companies to focus on their core competencies, spinning off secondary functions and support services, such as delivery and customer support, to third parties.
- In the next decade approximately 10 million jobs will open up for professionals, executives, and technicians in the highly skilled service occupations. However, many of these positions may be for part-time workers.¹⁴
- The information-based organization depends on task-focused specialists. Globalization requires more independent specialists.
- By 2020, most companies will be globally networked, highly decentralized entities that operate around the clock. Their virtual teams of freelance and on-contract personnel will be coordinated through a digital nervous system over the Internet.
- Companies will range from mini to mega in size. There will be perhaps 100 mega corporations worldwide, perhaps a million niche companies, plus a billion family-operated “webpreneurial” firms, with very few large-to-mid-sized firms still surviving.¹⁵

¹¹ Henderson, Carter. “How The Internet is Changing Our Lives”, *The Futurist*, July/Aug 2001.

¹² *Ibid.*

¹³ Cetron, M. and Davies, O, “Trends now changing the world: Technology, the workplace, management, and institutions” *The Futurist*, Mar/Apr 2001.

¹⁴ *Ibid.*

¹⁵ Feather, F, *Biznets: In Search of Online Excellence*, 2002.

Telecommuting and the rise of home offices

While offices have become more wired, so have alternative worksites. Although many office workers take work home with them, they are not necessarily telecommuting. Rather, the Bureau of Labor Statistics defines telecommuting as “an employee receiving pay for work done at an alternative site. Alternative sites include the home, satellite offices, telecenters, or anyplace else.”¹⁶ Most telecommuters work from this alternative location one to two days a week, according to the BLS. According to the Current Population Survey from the Bureau of Labor Statistics, about 3.3 percent of the workforce was made up of telecommuters in 1997.

It is estimated in 2001 that 24 percent of the US workforce, or about 32 million workers, telecommuted sometime during the workweek (Table 3).¹⁷ This is expected to increase to 28 percent of the workforce or 40 million telecommuters.¹⁸ Seventy percent of all US organizations with more than 5,000 employees offer employees telecommuting options.¹⁹ Telecommuting is most common in large organizations but is expected to increase in smaller organizations as well.

Table 3 Estimate of telecommuters and home-based business employees

Year	2001 (millions)	2004 (millions)
Estimated number of telecommuters in the US	32.0	40.0
Estimated number of telecommuters at home at least one day per week	6.4	8.0
Estimated number of home-based business employees	6.0	8.0
Estimated number of home-based business employees working at home at least one day per week	6.0	8.0
Total at home workers per day	12.3	16.0

Source: International Data Corporation, 2001; US Census Bureau, December 2001.

Telecommuters are much more technology dependent than traditional cubicle workers. For example, they rely heavily on the fax, telephone, the email, and the Internet to coordinate work and stay in touch.

Telecommuting provides definite economic benefits to employers that outweigh any additional costs. Employers report increased worker satisfaction and productivity among teleworkers. Telecommuting may cut the high cost of office space as well as the capital required to support the office. If a company employs 1,000 workers but 500 telecommute per day, the company can rent half as much office space. Telecommuting is also used as

¹⁶ Bureau of Labor Statistics, Current Population Survey 1997, <http://www.bls.gov/bls/>.

¹⁷ Cahners In-Stat Group, April 2002. <http://www.instat.com/>.

¹⁸ *Ibid.*

¹⁹ Sage Research, “Opportunities in Telecommuting: A Quantitative Analysis of Drivers, Deterrents and Deployment Patterns” Sage Research, January 2000, p. 6. as cited in Lovelace, G. *Telework and the New 21st Century*, Washington: DC. US Department of Labor. http://www.dol.gov/asp/telework/p1_2.htm#three.

a recruiting tool to attract and retain qualified workers. One study found that workers reduced travel by more than 32 miles per telework day indicating energy and environmental benefits.²⁰

The benefits are further illustrated by a study of a Telework Pilot Program begun by the State of California in 1987 involving more than 200 teleworkers, and 20 different departments of state government. An evaluation of the pilot project tested and disputed some of the common myths associated with telecommuting, as shown in Table 4.²¹ The program has now expanded to more than 3,200 official and at least 9,000 unofficial teleworkers from more than 150 departments of state government.

Table 5 and Table 6 display the industries and occupations that report the highest numbers of workers who telecommute. Clearly, most telecommuters work in service fields at either professional or administrative jobs. Telecommuting is also popular among sales professionals.

Closely aligned with the rise of the telecommuting is the rise of the small office/ home office (SOHO) that is now is the fastest growing segment of the US economy accounting for \$454 billion in annual sales. In 1997, there were 6.3 million individuals

Table 4 Assumptions and outcomes from the California Telework Pilot Program

Assumption/concern	Outcome
Productivity of teleworkers will drop.	It rose by an average of nine percent.
Technology costs will be excessive.	They were negligible compared to the productivity increases.
Employee loyalty will plummet.	It rose significantly as evidenced by a major reduction in employee departure rates.
There will be no impact on traffic.	Teleworkers do not use their cars when teleworking nor does anyone else.
There will be no impact on the environment.	When the car is not used there are no exhaust emissions.
There will be an increase in urban sprawl.	No net effect was detected. Some teleworkers moved farther from their main work site but just as many moved nearer.
Teleworkers will feel left out of the social activities in the workplace.	There were no detectable effects.
The management burden will increase.	Direct supervisors felt that their management efforts were made easier.

Source: State of California Telework Pilot Program, 1997, D. Fleming, Dept. of Personnel Services, <http://www.dpa.ca.gov/jobsnpay/telework/telemain.htm>

Table 5 Industry trends in telecommuting (May 1997)

Sector	Number of telecommuters
Services	1,616,000
Manufacturing	517,000
Wholesale trade	343,000
Finance, insurance, and real estate	330,000
Retail trade	289,000
Transportation and public utilities	205,000
Public administration	196,000
Construction	136,000

Source: Matthew Mariani, "Telecommuters" *Occupational Outlook Quarterly*, Fall 2000, pp. 11-17.

²⁰ *Ibid.*

²¹ Fleming, D., State of California, Department of Personnel Services, Sacramento, CA. <http://www.dpa.ca.gov/jobsnpay/telework/telemain.htm>.

(Table 3) who worked in full-time home-based businesses.²² It is estimated that 44 percent of US households have income generating or after-hours home offices.²³ This equates to 42 million households employing 50 million workers.

Future trends for the office market

The National Institute of Standards and Technologies (NIST) is launching a computing initiative that involves developing tests and standards that will encourage advances in fields ranging from wireless devices to wearable computers. NIST scientists believe three trends are shaping the future of the information technology industry: the growing number of computers per person in homes and offices, advances in miniaturization technology, and the phenomenal growth of the Internet. The convergence of these trends will result in an era of pervasive computing. Computers, actuators, and sensors will be embedded in virtually every device, appliance and piece of equipment, and even in clothing. One field that is ready for advanced research is the development of “smart spaces.” These are workspaces that have built-in computers, sensors, and communications devices, such as voice recognition systems. NIST currently is developing an experimental smart space as a first step in its pervasive computing initiative.²⁴

These changes in the workplace have led several companies such as IBM and Steelcase, an office furniture manufacturer, to try to anticipate the market direction. These office futurists envision a “smarter workspace” that will incorporate a variety of energy efficient technologies operating in the following ways:

In the BlueSpace cubicle, for example, a touch-screen beside the user's primary display tracks team members' whereabouts and availability, and cues instant messages for colleagues. The nature of work is changing just as dramatically as the technology is changing. . . Steelcase's customers increasingly want to figure out how to make employees' workspaces mesh with their office technology.²⁵

Table 6 Wage and salary workers paid for job-related work done at home (1997)

Occupational group	Number
Professional specialty	969,000
Executive, administrative, and managerial	867,000
Sales occupations	640,000
Administrative support, including clerical	611,000
Service occupations	256,000
Precision, production, craft, and repair	116,000
Technicians and related support	112,000
Operators, fabricators, and laborers	73,000
Total	3,644,000

Source: Matthew Mariani, “Telecommuters” *Occupational Outlook Quarterly*, Fall 2000, pp. 11-17.

²² US Census Bureau, December 2001. www.census.gov.

²³ BIS Strategic Business Decisions, as cited in “Work at Home - 2001,” Bureau of Labor Statistics Report, March 2002. <http://www.bls.gov/cps/>.

²⁴ Herman, H. National Institute of Standards and Technology Website, www.nist.gov/cgi-bin, Accessed Oct. 16, 2002.

²⁵ Ricadela, A. and Kolbasuk-McGee, M. “New Way to Work,” *Information Week*, Jan. 28, 2002, <http://www.informationweek.com/story/IWK20020124S0028>.

The corporate headquarters of the future

In much the same way that employees are using “virtual offices,” so too will corporations. According to Jim Schriner, the “virtual headquarters will be the option of choice for business leaders looking to reduce individual stress, organizational costs, and management distraction.”²⁷ These virtual headquarters will consist of “a laptop, cellular phone, and a calendar with designated blocks of days identifying in which city of the world the management team is to gather to concentrate their activities, plotting the future and leading the company.”²⁸ The face-to-face meetings will be supplemented by video conferencing, teleconferencing and other communications arrangements such as the Internet.

The advantages of such arrangements are that organizations will be able to recruit the best talent globally, minimize problems of work permits and relocation for executives, and allow executives to have and sustain a high quality life style supported by the flexible organizational arrangements. Further, such virtual headquarters will allow firms to project their presence by “conducting activities such as press conferences, management meetings, and board meetings in a number of global locations to emphasize selected goals.”²⁹

Faith Popcorn on office trends in America²⁶

Non-territorial offices: No one has his/her own desk, but rather offices are assigned based on whoever is in the office at the time. Popcorn thinks that digital personalization will be offered such as storing family photos so that workers will be able to “nest” in these temporary quarters. (p.75)

Permalance: The merger of permanent and freelance workers who become knowledge workers that are both dedicated to the company and free agents at the same time. (p. 76)

CoHo (short for corporate office home office): Corporations will fund all or a portion of the cost establishing and maintaining home offices. This will reduce the cost of real estate investments in expensive locations, and allow the expensive corporate office space to be reduced. (p. 80)

Cubicle fever (the feeling of entrapment experienced by cubicle workers): Cubicle fever will mount as economic pressures and rents are force employers to stack workers into a smaller workplace. Cubicles are now smaller than some prison cells. (p. 154)

Hypersurface architecture: The skin of a building takes on a whole new utility, including electronic and digital technologies that transform an outside wall into a communications platform. The building becomes a dynamic medium. (p. 15)

²⁶ Popcorn, F. & Hanft, A. *Dictionary of the Future-The words, terms and trends that define the way we'll live, work, and talk*, NY: Hyperion, 2001.

²⁷ Schriner, J. “What the Future Holds for Corporate Headquarters?” Fantus Consulting, a division of Deloitte & Touche LLP. http://www.facilitycity.com/busfac/bf_99_07_cover1.asp.

²⁸ *Ibid.*

²⁹ Schriner, J. “What the Future Holds for Corporate Headquarters.” Fantus Consulting, a division of Deloitte & Touche LLP. http://www.facilitycity.com/busfac/bf_99_07_cover1.asp.

A corporate headquarters building at a fixed location with large numbers of personnel may be a thing of the past. Schriener suggests that headquarters may be a 20,000 square foot Class A facility with flexible space and advanced communications systems located at or near an airport. Headquarters will be a center for communicating and coordinating the activities of the dispersed organization.³⁰

Future trends in the retail market

“Time is becoming the world's most precious commodity”³¹

This prediction made in *The Futurist* magazine has widespread implications for retail establishments. According to *The Futurist* magazine, single workers and two-income couples are so pressed for time that they will purchase any product that promises either to “simplify their lives or grant them a taste of luxury-and they can afford to buy it.”³² For retailers, this means that as time for shopping continues to evaporate, Internet and mail order will have a growing advantage over traditional stores.

Micro-segmentation

The next decade will also become one of “micro-segmentation” with more niche products, retailers, and businesses. Chain department stores and giant discounters will succeed because of their ability to offer anything and everything to a potential customer. Smaller specialty boutiques will become even more prevalent, offering products and services from customized kitchens to custom-built surfboards. These smaller niche stores will succeed as customers search, most likely on-line, for the best products they can find for their time-compressed lives. It is the non-descript, non-adaptive, and without-brand retailer that fails to take advantage of the Web who is likely to find it most difficult to survive.

Several factors have been driving these changes in the retail market including:

- Declines in the traditional market segments
- Growing sophistication of direct marketers
- Shopping as entertainment
- Changing consumer demographics
- Growth in on-line shopping
- Changes in key market players³³

Table 7 provides examples of some of these trends.

³⁰ *Ibid.*

³¹ Cetron, M. and Davies, O. “Trends now changing the world: Technology, the workplace, management, and institutions,” *The Futurist*, Mar/Apr 2001.

³² *Ibid.*

³³ Plunkett, J. and Barbier, K. (eds). *Plunkett's Retail Industry Almanac*, 2002.

Table 7 Major trends driving retail markets

Declines in traditional segments	Growing sophistication of direct marketers	Shopping as entertainment	Changes in the key market players
Continued decline of the mom-and-pop store	Sophistication and success for direct-marketers	Entertainment as a major draw to the retail environment	Repositioning of full-price/multi-line department stores
Problems for traditional, full-price chain stores	Growth of sales on the Internet	Continuous changes in demographics, tastes and fashions	Supremacy of the discount store chains
Some weakening of category killer superstores	Bricks and clicks (extending sales from a physical location)	Advances in management information	Repositioning of wholesale distributors
Dwindling appeal of the major mall		Easy availability of consumer credit	Success for premium-priced stores Down-selling

Source: Plunkett, J. and Barbier, K. (eds). *Plunkett's Retail Industry Almanac*, 2002.

Declines in traditional retail segments

The retail marketplace is becoming dominated by a handful of giant retail “power players.” There are fewer retailers and the largest retailers are growing larger through expansion and acquisition.

These shifts have effectively forced traditional “mom and pop” stores out of business or required them to develop new and innovative ways to serve their customers. Furthermore this blurring of the lines between retail segments and the rise of the superstores suggest that customers will increasingly be looking for one-stop shopping.³⁴

Growing sophistication of direct selling

Superstores are battling each other on every major corner while direct-marketers are stealing customers from stores. Every dollar reaped by non-store direct selling is a dollar taken away from a sale that would have been occurred in a retail store. Direct-to-consumer selling already accounts for more than 2.6 percent of all non-automobile retail sales in the U.S.

This increase is due to the growing power of the Internet. Many traditional retailers have begun using the Internet to reach out to customers in new and innovative ways. According to a survey conducted by the Main Street Historical Trust, *The 2001 National Main Street Trend Survey*, revealed that the Internet was affecting the ways that retailers try to market to customers.³⁵

³⁴ Libman, W. “The Consumer Paradox: The Threat to Loyalty in the New Millennium,” *WSL's Survey: How America Shops*, WSL Strategic Retail, 2001, p. 6. <http://www.wslstrategicretail.com/publications/edge/prev/>.

³⁵ *Ibid.*

- Some businesses are using the Internet to improve customer service to *existing customers*. For example, a department store in Georgia provides gift certificates to customers that provide email addresses. The store then sends tailored email messages to inform these customers about upcoming sales and new arrivals.
- Businesses are using the Internet to increase sales in their *bricks-and-mortar stores* or offices. For example, some stores use the Internet to sell used equipment while promoting new equipment in their traditional stores.
- Businesses have shifted *exclusively* to the Internet. Many retailers, especially those with customized products or services, have found success in broadening their target market through the worldwide reach of the Internet.³⁶

This trend will only increase in the next decade. Futurists at George Washington University predict that by 2007 nearly one-third of all shopping will take place on-line. Consumer shopping on-line is growing at half the rate of TV shopping.³⁷

Shopping as entertainment

One factor driving this shift is the growing consumer expectation that “shopping is an experience.” Even though customers may be pressed for time, more are looking for ways to combine shopping with entertainment. The mega-malls, such as the Mall of America in Minnesota, are the most obvious indicator of this trend. These super-malls offer consumers choices ranging from movie theaters, amusement parks, swimming pools, and of course, shops and restaurants. These centers are designed to entertain shoppers as much as sell products and services.

Shopping is becoming more (of) a leisure activity, and from the outset the [Trafford] Centre was conceived on a grand scale so as to attract shoppers and entertain them from the moment they enter.³⁸

Trafford Centre includes four large shopping malls, and includes three square miles of shopping with 280 shops. It also includes a movie theater, a bowling alley, an arcade with interactive computer games, a children's entertainment area, a TV wall, and a total of 6,000 restaurant seats.³⁹

The Mall of America in Minneapolis is even bigger (Table 8). In the next few years, new construction is expected to add as much as five million square feet, more than doubling the Mall's original 4.2 million square-foot structure.

Even more compelling is the impact that this mega-mall has had on American culture. A study conducted in 1997 by the National Park Service and *Road Smart Magazine* listed the Mall of America as the most visited destination for U.S. travelers. *The New York Times* reported that the Mall of America attracts more visitors annually than Disney World, Graceland, and the Grand Canyon combined. A national reader poll survey con-

³⁶ Main Street Historical Trust, “The 2001 National Main Street Trend Survey,” <http://www.mainst.org/programs/TrendsSurvey/2002PressRelease.html>.

³⁷ GWForecast.gwu.edu.

³⁸ Johnson, Dan. “To market, to market, to have a good time.” *The Futurist*, Washington: November 1999.

³⁹ *Ibid.*

ducted by the American Bus Association reported that readers voted the Mall of America as the best shopping destination in the United States.⁴⁰

Table 8 Operating statistics about the Mall of America

Date opened	August 11, 1992
Visits since opening	More than 350 million
Weekly visits	Ranges from 600,000 to 900,000 depending on season
Cost to build	More than \$650 million
Owners	Simon Property Group; Teacher's Insurance & Annuity Association; and Triple Five Corporation
Gross building area	4.2 million square feet
Gross leasable retail space	2.5 million square feet
Number of stores	More than 520
Number of sit-down restaurants	22
Number of fast-food restaurants	27
Number of specialty food stores	34
Number of nightclubs	8
Number of theater screens	14
Occupancy as of August 2001	99 percent
Economic impact on Minnesota	Nearly \$1.6 billion annually
Employees at Mall of America	11,000 year-round employees; 13,000 (during summers and holidays)
Parking spaces at Mall of America	13,000 (during summers and holidays); 12,750 on-site; 7,000 off-site
Percent of visitors from outside 150-mile radius	37 percent
Key attractions	Camp Snoopy, Underwater Adventures, LEGO Imagination Center, Cereal Adventure, Planet Hollywood, Rainforest Café, Macy's, Bloomingdale's, Nordstrom, Sears
Walking distance around one level	0.57 mile
Total store front footage	4.3 miles

Source: Mall of America, Fast Facts, www.mallofamerica.com (2002)

⁴⁰ www.mallofamerica.com, accessed Sept. 16, 2002.

Changing consumer demographics

The nature of the American shopper is also changing dramatically. According to the *WSL's Survey, How America Shops*, American customers are becoming even more contradictory and they expect immediate response and endless selection.⁴¹

- Consumers are shopping more often even though they say they don't have the time. The percentage of people reporting a shopping trip per week has increased from 30 percent in 1995 to 36 percent in 1997.⁴²
- Consumers are shopping more but buying less. Shoppers continue to purchase necessities, such as food, personal care products, and medicines. However, they are buying fewer non-essentials such as cosmetics, accessories, and home furnishings.⁴³
- Selection drives the decision. Product selection has become the number one reason that consumers say they choose a particular outlet.
- If they are not satisfied, customers will look elsewhere. This lack of patience explains the willingness to shop more outlets, the willingness to browse before they buy, and the hard-nosed refusal to buy categories of machines they no longer believe meet their needs for selection, innovation, or problem-solving.
- Two segments in particular are increasing in importance: the 55+ segment and the ethnic market. Traditionally, these segments were considered niche markets. But, they have grown so much that now they are influencing retailing decisions on a much larger scale. The 55+ segment represents 33 percent of all adults in this country and various ethnic communities, Hispanic, African-American, and Asian-American shoppers, comprise 30 percent of the U.S. population. While the senior segment shops less frequently, the ethnic segment shops much more frequently.

Growth of on-line shopping

The move to one-stop shopping will also contribute to the growth of on-line shopping. Futurist Frank Feather predicts that by 2010, 83 percent of all North American households will have at least one personal computer, 79 percent will be on-line, and 66 percent or approximately 76 million households, will shop and buy regularly on-line.⁴⁴ Figure 6 illustrates how the growth of on-line shopping is linked to increasingly high ownership levels of personal computers that lead to Internet surfing and eventually online shopping.

Changes in key market players

These changes have also forced a realignment of the key market players within the retail segment. This includes:

- Repositioning of full-price/multi-line department stores

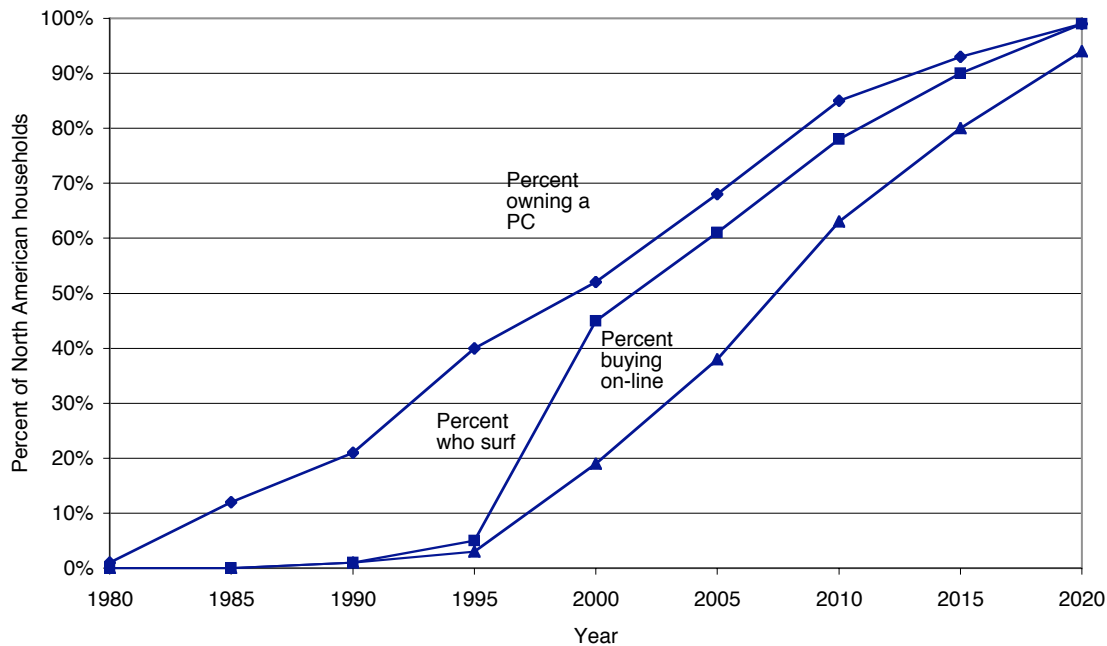
⁴¹ "The Consumer Paradox: The Threat to Loyalty in the New Millennium", *WSL's Survey: How America Shops*, WSL Strategic Retail, 2000, pp. 6-99.

⁴² *Ibid.*

⁴³ *Ibid.*

⁴⁴ Feather, Frank. *FutureConsumer.com: The Webolution of Shopping to 2010*. 2nd ed. Toronto: Warwick Publications, 2002, p. 123.

- Supremacy of the discount store chains
- Repositioning of wholesale distributors
- Success for premium-priced stores
- Down-selling



Source: Innovologie reconstruction of data from F. Feather, *FutureConsumer.com: The Webolution of Shopping to 2010*. 2nd ed. Toronto: Warwick Publications, 2002, p. 123.

Figure 6 Estimates of PC ownership, Web access and shopping by North American households

Some consequences of the shift in power to large, dominant retailers mean that the retailer is now the “brand.” A good example of this is Target. The large, strategic retailers are looking for strategic partners who can be “category captains” that can execute reliably and efficiently to reach performance goals.⁴⁵

Future trends for restaurants

Susan Mills has identified a number of trends for 2010 in the restaurant industry.⁴⁶ These changes include continued rapid growth, increased capitalization of restaurants, escalating costs of operating restaurants, more involvement from institutional investors, a more prominent role for minorities and women in the restaurant business, more targeting of clientele, increasing attention to the quality and healthfulness of foods, and more involvement of suppliers in food production. As we shall see later when we discuss the restaurant industry, many of these trends are well underway.

⁴⁵ Integrated Marketing Solutions, LLC. 2002

⁴⁶ Mills, S. “Guide to Success in 2010,” *Restaurants USA*, September 1999.

The “Restaurant of the Future”

According to Beth Panitz, by 2010, successful restaurateurs will incorporate high tech applications into everyday operations.⁴⁸ Restaurateurs will use technology to better manage their businesses. Furthermore, technology will give operators new tools to control costs and improve management efficiency. Restaurant kitchens in the future may include the following types of technologies:

- Robots that automatically flip hamburgers and hotcakes on the grill
- Rapid cooking and pre-programmed ovens
- Under the counter blast chillers
- Intelligent appliances

Several appliance manufacturers have developed ovens that dramatically reduce both the time and labor involved in preparing and cooking food. These new appliances, such as the Accellis Oven and the FlashBake Oven, use a variety of heat sources, including hot forced air, microwave energy, and light waves to significantly reduce cooking time. The FlashBake Oven cooks food two-thirds faster than conventional ovens.⁴⁹

Manufacturers are developing kitchen equipment that is "smarter." This equipment has microprocessors and complex circuitry that allow it to "remember" how to perform certain operations, to track cooking and holding temperatures, and to "know" when servicing is needed to prevent a breakdown.

Computerized equipment that "knows" how to cook food is already becoming popular. "Microchips allow operators who do repetitive tasks to push a button and get the same results every time," says Mitchell Schechter, editor-in-chief for *Foodservice Equipment & Supplies*.⁵⁰ For example, combi-steamers, which use a combination of convection and steam, "know" how to cook specific items.

Faith Popcorn on retail trends⁴⁷

Brivo: This new solution for accepting deliveries when customers are not at home was pioneered in Europe and involves a secure, steel-reinforced container that links the merchant, shipper, and consumer. (p. 286)

Consumer serfs: Describes the way retailers turn customers into workers, such as clearing their own tables, bagging their own purchases, etc. New technologies in supermarkets have shoppers doing their own checkouts. (p. 254)

Geo-targeting: Using a wireless phone with a cookie, a marketer knows where you are and can send local commercials and messages showing you where Old Navy or the nearest donut shop is located. (p. 255)

Smart stores: Chains of retail stores selling a full complement of “smart” technologies including smart tires, smart clothing, etc. (p. 266)

⁴⁷ Popcorn, F. & Hanft, A. *Dictionary of the Future-The Words, Terms and Trends that Define the way We'll Live, Work, and Talk*, 2001, Hyperion, NY. pp. 254-255, 266, 286.

⁴⁸ Panitz, P. “Smart Kitchens: Science Fiction or High-Tech Reality?” *Restaurants USA*, October 2000.

⁴⁹ *Ibid.*

⁵⁰ *Ibid.*

In the future, smart equipment might even respond to voice commands. A kitchen staffer could simply tell an oven to "cook five pizzas," instead of using a keyboard to go through menu options. GE has already produced a prototype of a voice-activated oven for consumer use. Users tell the oven what they are preparing and it activates a stored menu consisting of the proper cooking time and temperature. It is programmed to recognize more than 200 regional accents.⁵²

Faith Popcorn on food sales trends in America⁵¹

Bankaurants: These facilities will be banks in the morning/afternoon and restaurants in the evening. (p. 186)

CafeFearia: This refers to the growing concern over food-borne illnesses that are spread through school cafeterias. This is also related to concern for food processing snafus. (p. 186).

Flash bake oven: A new cooking technology that uses visible and near visible light, to yield conventional oven results at faster speeds. This technology is expected to create a variety of new supporting industries. (p. 180)

Food bars: These are communal counters or "share tables" where single diners or groups gather at one long table. (p. 180)

Food spas: More spas are using food and beverages as part of their de-stressing, immune boosting, and purifying regimens. This is also called topical nutrition. The next step will be "home delivery" of these food spa treatments. (p. 181)

Mobile prep: This refers to restaurants that deliver prepared meals to homeowners. These will be sophisticated "KitchiVans" that will roam the roads complete with pizza ovens and grills. (p. 187)

Subscription restaurants: A concept that will feature celebrity chefs that will open cool, hip restaurants y subscription only. Customers will invest in a "food bond" in advance, and depending upon the amount, they will be entitled to a certain number of meals per month. These food bonds will have liquidity and can be sold to others for a profit. (p. 188)

Super-sizing: Everything will be bigger including family style restaurants, homes, home theatre screens, etc. (p. 267)

Zipzones: This refers to guaranteed no-waiting zones in restaurants, banks and other stores. Pay a yearly fee for a smart card that lets a person pass everyone else. The checkout process is outsourced from the merchant to the zipzone. (p. 267)

Another possibility is that smart equipment would be able to detect what food is to be cooked and then cook it appropriately thereby eliminating any possibility of user error. GE has already developed a prototype microwave with a bar-code scanner.⁵³

⁵¹ Popcorn, F. & Hanft, A. *Dictionary of the Future-The words, terms and trends that define the way we'll live, work, and talk*. New York: Hyperion, 2001, pp. 181-188, 267.

⁵² Panitz, B. "Smart Kitchens: Science Fiction or High-Tech Reality?" *Restaurants USA*, October 2000.

⁵³ *Ibid.*

The smart kitchen of the future will be more than a collection of intelligent equipment, say visionaries. The truly smart kitchen will interconnect equipment to a central network. The networked kitchen will have a central "dashboard" computer that can send and receive information to and from all equipment.

A networked kitchen could also improve energy management. The central computer could monitor and control the energy usage of each piece of equipment, scheduling high-energy tasks for off-peak times. It could scatter peak-usage intervals, such as when a refrigerator's compressor runs, to avoid a system overload.

Visionaries also predict that the kitchen network will have two-way communication, through the Internet or a local area network, with food suppliers, corporate headquarters, equipment manufacturers, and more. The on-line kitchen could contact suppliers to order needed foods, receive new cooking parameters, and notify the manufacturer when a repair is needed.

Using an Internet hookup, manufacturers could potentially diagnose service problems remotely. The result, the repair person would pinpoint the exact problem before trudging out to the restaurant and would bring the needed part on the first service call.⁵⁴

Future trends in food sales

Time-pressed consumers will also be a major driving factor in the supermarket industry. Not only will consumers be interested in eating out, they will also be looking for quick and easy to prepare food.

America's desire for convenience foods — meats cut up, marinated, and ready for the grill; entrees in microwavable packaging; individual juice boxes for bag lunches; and the large portion of our meals prepared by foodservice companies — translated into \$466 billion in sales in 1998. This trend is expected to continue with increased product offerings available in the supermarkets.

Trends in on-line ordering and delivery

Smart appliances and web-based grocery stores will be linked increasing the services available to the customer. Smart appliances will read product bar codes and build grocery lists for the placement of orders automatically over the Internet.⁵⁵ Frigidaire has developed a refrigerator that is equipped with a microprocessor, touch screen, bar-code scanner, and communications port. This refrigerator allows consumers to automate their grocery shopping. Whenever customers are low on a given product, they simply swipe the carton past the refrigerator's bar-code scanner that adds that item to a list.

When the consumer is ready, the list can be transmitted to the local grocer. The groceries will either be delivered to the consumer's door or packaged for pickup at a convenient time for the shopper. The back-end of this arrangement is already in place because Web-based grocery sites already retain shopping lists so that the customer has only to modify the existing list for the next delivery.

⁵⁴ *Ibid.*

⁵⁵ Windsor Marketing Group, 1998. <http://www.windsormarketing.com/>.

Corporate information officers in the grocery industry are putting in the technical infrastructure to collect and consolidate customer data. New point-of-sale systems that interact with fledgling Web commerce ventures will be coupled with database mining tools letting companies analyze customer behavior to an unprecedented degree. Club cards allow grocers to connect multiple purchases and social and demographic information. Grocery products will be delivered in just the right number at the right time. Planning algorithms will analyze sales receipts to identify paths through the store and product placement and will dynamically provide plans to reallocate space on the shelves to increase sales and optimize the time for customers to travel through the store. As the cost of radio frequency identification tags (RFIDs) fall, the relatively cumbersome bar code may be replaced, speeding check out and providing other benefits to the customer and the grocer.

More upscale displays⁵⁶

Not only will products and services change but also the store's ambiance. Retailers will start offering "stress-free" havens because heavily stressed baby boomers will not shop at a store that adds to their stress. The signs will have softer colors and item-appropriate background music will promote a relaxed atmosphere. A credible but soothing voice coming from locations or signs in various departments will provide cooking tips or weekly specials.

The layout of grocery stores of the future will also change. The produce department will be expanded to reflect consumer interest in cooking and nutrition. Because nutrition-conscious and gourmet customers will demand more choices, stores that once offered 50 varieties of produce will carry up to 400 different items. Improvements in technology will provide stores with the most vibrant silk-screened signs that can be color-coordinated with the produce and be changed frequently.

Other departments will follow the "open air" feel of the produce department. Many stores will set up their butcher in the center of an area where people can walk through. Butchers will become much more accessible and will be more available to explain certain cuts of beef and offer tips on how to prepare different meats. Supermarkets will also make getting food easier by offering a drive-through window for meal pickups, for example.

Future retailers must be increasingly sensitive to the constraints of an aging baby boomer population of which 40 percent have arthritis. Tightly packed shelves stacked up to the ceiling or close to the floor will be obsolete. Stores will adjust lighting to accommodate the many customers with reduced eyesight as well as providing enhanced signage with larger type and signage lit to enhance visibility.

More emphasis on "health" in groceries

Faith Popcorn, author and trend expert, believes the store of the future will offer "foodaceuticals," foods prescribed in daily doses to keep you alert and younger. These might

⁵⁶ Windsor Marketing Group, 1998. <http://www.windsormarketing.com/>.

include breads that can calm you down, special fruits for menopausal women, and foods that reduce stress and enhance energy.

Popcorn also thinks that menus will be suggested for every stage of life in the modern grocery store. She predicts that supermarkets will team up with healthcare providers to offer more health-related information. Servicing the needs of children will become increasingly important because children accompany their parents while the parents shop. A pediatrician could be available on-site for checkups and a nutritionist could teach kids about five-a-day programs.⁵⁷

Supermarkets as a place of learning

Another issue in the future of supermarkets will be managing the consumer's expectation of the grocery store. Supermarkets will instruct shoppers about how to use food. Positioning the store as a trusted information agent will enhance a store's image and add value to the shopping experience. Pamphlets, brochures, and signs will help consumers filter choices and educate them about the best purchases for their individual needs.

Bringing back the old-fashioned concept of personalized service will be popular in the future as well. If a customer likes a certain cut of beef or type of cheese, he or she can be contacted by e-mail when the product arrives.⁵⁸

Future trends in the healthcare segment

A number of outside factors will affect healthcare in the future. These include advances in technology, an aging population, increased demand for new products and services, and a growing inter-connection among healthcare providers. Future health care providers will make the delivery of many health services as convenient as shopping for clothes or food. Some services will continue to be more effective when patients and doctors or therapists meet in person. Recreational activities, restaurants, and personal contact services will thrive in mall-type settings.⁵⁹

Technical advances

Writer James Wooten also described some of the promising improvements in healthcare that are likely to emerge in the next two decades⁶⁰. Several areas show promise for actually improving people's health.

- The Human Genome Project will result in the isolation of the genetic roots of many human diseases including many that are not generally considered genetic

⁵⁷ Popcorn, F. & Hanft, A. *Dictionary of the Future-The words, terms and trends that define the way we'll live, work, and talk*. New York: Hyperion, 2001.

⁵⁸ Windsor Marketing Group, 1998. <http://www.windsormarketing.com/>.

⁵⁹ Wooten, J. "Health care in 2025: A patient's encounter." *The Futurist*. Vol. 34, Issue 4, Jul/Aug 2000, pp. 18-22

⁶⁰ *Ibid.*

- The use of these genetic markers to screen mass populations and prevent (through diet, gene substitution, or other special therapies) the specific diseases that individuals are likely to develop.
- Nanotechnology holds the promise of completely new types of drugs. These molecular-scale machines will have the tools and intelligence to perform specific tasks such as killing certain viruses, repairing certain cells, and manufacturing certain needed proteins or enzymes.
- New modes of pharmaceutical research go far beyond the blind trial and error techniques to building the molecules (or evolving the bacteria) that can carry out specific tasks, lock onto specific receptor sites in the body, or defeat specific pathogens. The next 20 years will see a big change in drug treatment as scientists learn more about brain disorders and discover effective therapies for depression, schizophrenia, and senility.
- Biotechnology will also influence a variety of medical applications including manufacturing new products, genetic engineering, gene splicing, and cloning. It may also lead to bionic implants to replace various body parts such as artificial eyes, limbs, hearts, and kidneys⁶¹.

A very important aspect of all of these technologies is that they are likely to be provided outside of acute care facilities in office settings. As a result, we are likely to continue to see a movement of healthcare from specialized facilities to office settings.

Shifts in direction

Another futurist predicts that healthcare information will become more accessible which will lead to better and more responsive healthcare for Americans.⁶²

- Health kiosks at the mall will handle patients' needs for medical tests, cancer screening, diagnosis, and referrals for specialty care.
- Computers, telecommunications, and databases will allow doctors to communicate more easily and quickly. This will also allow healthcare managers to drive their systems in real time while pushing consumer awareness about health to entirely new levels using interactive cable systems, on-line forums, and personal health information systems in a wide variety of formats.
- Outcomes management and expert systems will use databases scanning millions of cases to determine what therapies actually work best in particular circumstances. The use of management tools will make the practice of medicine more a science and less a craft, driving down costs and improving quality. This will open the gates to a number of highly effective and inexpensive non-medical methods that are considered "alternative." Their widespread use is likely to significantly change the role of a doctor from one of knowing facts to the more human elements of the craft such as making difficult judgments and helping patients change their behavior.

⁶¹ *Ibid.*

⁶² Flower, J. "The Future of Healthcare," *Encyclopedia of the Future*. Macmillan and Company, 1996.

These trends have a number of implications for where medicine is practiced. The focus of healthcare will move increasingly out of the acute care hospital, and back to clinics, doctors' offices, and even schools, workplaces, and the home. The focus will change from intervening in the acute phase of the disease toward early screening, detection, and treatment, and toward disease prevention.

Acute healthcare facilities will continue to shrink drastically. In 1982, for every thousand United States citizens, American hospitals logged 1132 nights in a hospital bed, more than one night per citizen. By 1992, that had dropped to 607. By 1995, some states were as low as 225, and some specific markets (such as San Diego County, California) as low as 160.

Health futurist Jeff Goldsmith estimates that within a decade, most markets will only log 70 or 80 nights in a hospital per year for every 1000 citizens. One-third to one-half or more of all hospitals will close. The rest will shrink and become much more intensive. Almost all will join one of the many different large-scale organizations that are bringing together hospitals, doctors, payment structures, and many other services under single ownership.⁶³

Future trends in the lodging market

Issues affecting the larger tourism market — specifically an aging population, new technology, increased safety concerns, and airfares — drive the lodging market.

Obviously, terrorist attacks in tourist locations throughout the world have led to a decline in the short-term demand for travel and lodging. Even though travelers are becoming accustomed to the heightened security requirements, threats of terrorist attacks may continue to depress travel demand.⁶⁴

Electronic devices for interpersonal communications are becoming more important in the travel industry. For example, teleconferencing saves time and money and reduces the need for hotel stays. The trend toward teleconferencing and interactive Web conferencing (IWC) means that what was once a major investment in sophisticated equipment will soon become an affordable option. IWC will permit people to meet in cyberspace and then return to home bases in relative security.

Another emerging trend is the interest in virtual travel technology that simulates the visual experience of various destinations. Discretionary dollars that would have been spent on travel may be used for electronic equipment that promotes virtual travel.

Within the lodging market, there may be an upswing in the creation of more spas and health resorts. There is also a rise in demand for all-inclusive family-oriented resorts and more “urban playgrounds” that offer 24-hour service.

⁶³ *Ibid.*

⁶⁴ Tarlow, P. “Tourism in the twenty-first century,” *The Futurist*, Washington; Sep/Oct 2002

Trends in the warehouse segment

One major way that warehouses will adapt to the needs of customers is to fundamentally change the way in which they are designed. The warehouse of the future will provide value-added services in the supply chain. Therefore, warehouses will have to change their design from that of *holding* facility to *logistics* facility.⁶⁵ As the demand for warehouse space increases, warehouse operators will either construct a new facility or adapt an existing building.

Warehouse operators are focusing on ways to increase throughput. Thus, they are developing flow-through or cross-docking facilities. Goods enter one side of the building, are reconfigured to customer/shipment requirements, and immediately move out the other side of the building. According to a recent survey conducted by Arnold Maltz at the University of Arizona in Tempe and cited in the industry trade publication *Industry Week*, "high-performance warehouses cross-dock 50 percent or more of incoming goods and set targets of 25 to 50 turns per year."⁶⁶

In response to just in time pressures, manufacturers are reducing their distribution facilities and outsourcing logistics. They are also frequently relocating supply chains. As a result, warehouses are taking on new functions. Warehouses are now responsible for making post-production changes to products, making packaging modifications, doing quality testing, assembling displays, and handling returned goods processing.⁶⁷

Because of these new tasks, computerized warehousing management systems are becoming increasingly important. This is introducing new opportunities and new problems for warehouses.⁶⁸

The new warehousing functions are also impacting the design of buildings. Warehouses are being made narrower with fewer square feet per door. Truck parking lots are becoming larger to accommodate more trailers. Such changes are resulting in about an 18 percent increase in the cost of buildings.⁶⁹

"I think a lot of the future of warehousing is about transformation management," concludes Robert Auray, Jr., president and CEO of USCO Logistics, Naugatuck, Conn. "This transformation management could be anything from coordinating and sequencing the inbound flow of parts to a production line, to managing a consolidation center filled with consignment inventory that supplies a network of retail stores with just-in-time merchandise, to customizing products to final customer orders."⁷⁰

⁶⁵ Harrington, L. "Digital Age Warehousing," *Industry Week*, on-line article.

⁶⁶ *Ibid.*

⁶⁷ *Ibid.*

⁶⁸ Staff, "How third-party logistics providers are using IT to improve performance," *Warehousing Management*, October 1, 2002.

⁶⁹ Harrington, L. "Digital Age Warehousing," *Industry Week*, on-line article.

⁷⁰ As quoted in Harrington, L. "Digital Age Warehousing," *Industry Week*, on-line article. http://www.findarticles.com/cf_dls/m1121/14_248/55221290/p4/article.jhtml?term=

Future trends in education

Perhaps the most dramatic area of change in the educational sub-market has been the rise of on-line educational offerings, especially at the post-secondary level. This trend is expected to increase as the need for advanced education continues and the demand to offer flexible schedules to meet busy students' needs increases.

The rise of on-line education will influence the demand for buildings and the way buildings are structured.

Trends in private for-profit post-secondary institutions

Three recent studies focused on the newest trend affecting post-secondary educational institutions — the emergence of new types and kinds of post-secondary educational providers.⁷¹ Many of these providers are for-profit or virtual institutions or both. It is estimated that there are 650 for-profit degree providers and several thousand institutions offering some level of virtual instruction.⁷² These new providers are entering the market very rapidly. These institutions appear in many types and forms including:

- For-profit, virtual institutions (e.g., Jones International)
- For-profit institutions with virtual offerings (e.g., University of Phoenix)
- Consortia (e.g., Western Governor's University, Southern Regional Electronic Campus, Colorado Community College Online)
- Franchises (e.g., Cardean University)
- For-profit spin-offs of established non-profit institutions (e.g., NYUOnline).⁷³

This study also revealed several emerging trends regarding the types of students and courses offered at these educational facilities.

While private for-profit institutions enroll only eight percent of all postsecondary students, they enroll 16 percent of all black students, 14 percent of Hispanic students and four percent of Native American students.⁷⁴

- In 1990, according to U.S. Department of Education figures, private career colleges graduated 61 percent of students with degrees in trade and industry while public

⁷¹ "Policy for Higher Education in a Changing World: Briefing on New Providers," Providence: The Futures Project, Brown University, April 2000. http://www.futuresproject.org/publications/new_providers_brief.pdf. See also Newman, Frank and Lara Couturier, *The New Competitive Arena: Market Forces Invade the Academy*. Providence: The Futures Project, Brown University, 2001. www.futuresproject.org. "Policy for Higher Education in a Changing World: An Update on New Providers," Providence: The Futures Project, Brown University, April 2002. www.futuresproject.org.

⁷² Newman, Frank and Lara Couturier, *The New Competitive Arena: Market Forces Invade the Academy*. Providence: The Futures Project, Brown University, 2000. p. 4 and especially footnotes 19 and 20. www.futuresproject.org.

⁷³ "Policy for Higher Education in a Changing World: Briefing on New Providers," Providence: The Futures Project, Brown University, April 2000, p.2. http://www.futuresproject.org/publications/new_providers_brief.pdf.

⁷⁴ "A Coming of Age," *Community College Week*, January 24, 2000.

community colleges graduated 21 percent of those students. That same year, 60 percent of students with degrees in communication technologies came from for-profit institutions while 21 percent graduated from public two-year colleges.⁷⁵

- According to U.S. Department of Education figures, the average tuition cost is less at private for-profit than at private nonprofit institutions.
- The University of Phoenix, with campuses in 120 cities and more than 130,000 students, is the largest private university in America.⁷⁶ Jones International University (a for-profit institution) is the first fully on-line accredited university.⁷⁷

For-profit institutions

According to the Education Commission of the States, there are over 650 for-profit degree-granting institutions. These ventures include:

- Columbia University's for-profit on-line venture to make their scholarly materials available with the New York Public Library, the British Library, the Smithsonian Institution's National Museum of Natural History, the London School of Economics and Political Science, and Cambridge University Press.⁷⁸
- In May of 2003, the University of Phoenix claimed on-line service to 72,000 students.⁷⁹ In absolute but not relative terms, this is higher than in 2000 when it was noted that the fiscal 1999 on-line enrollment of the University of Phoenix was 72 percent of the total students and grew almost 60 percent from the previous fiscal year.⁸⁰
- The number of corporate universities has increased from 400 in the early 1980s⁸¹ to 2,000 in 2001.⁸² Forty percent of Fortune 500 companies have a corporate university. It is estimated that there may be more corporate than traditional universities by 2010.⁸³

⁷⁵ *Ibid.*

⁷⁶ *University of Phoenix Fact Book*. University of Phoenix, 2003, p 25. <http://www.phoenix.edu/factbookweb/25.asp>.

⁷⁷ Jones International University, 2003. <http://www.jonesinternational.edu/aboutJIU/index.php>

⁷⁸ Arenson, Karen W. "Columbia in Web Venture to Share Learning for Profit." *New York Times* 3 April 2000: A22. as cited in "Policy for Higher Education in a Changing World: Briefing on New Providers," Providence: The Futures Project, Brown University, April 2000. p. 1. http://www.futuresproject.org/publications/new_providers_brief.pdf.

⁷⁹ *University of Phoenix Fact Book*. University of Phoenix, 2003, p 26. <http://www.phoenix.edu/factbookweb/26.asp>.

⁸⁰ Carlson, Scott. "U. of Phoenix Reports 22 percent Rise in Enrollment." *The Chronicle of Higher Education*. October 29, 1999, A56. as cited in "Policy for Higher Education in a Changing World: Briefing on New Providers," Providence: The Futures Project, Brown University, April 2000. p. 1. http://www.futuresproject.org/publications/new_providers_brief.pdf.

⁸¹ Meister, Jeanne C. *Corporate Universities: Lessons in Building a World-Class Work Force*, Rev. and Updated ed. New York: McGraw Hill, 1998, p. 268. as cited in Newman, Frank and Lara Couturier, *The New Competitive Arena: Market Forces Invade the Academy*. Providence: The Futures Project, Brown University, 2001, p. 26. www.futuresproject.org.

⁸² Newman, Frank and Lara Couturier, *The New Competitive Arena: Market Forces Invade the Academy*. Providence: The Futures Project, Brown University, 2001, p. 26. www.futuresproject.org.

⁸³ Meister, Jeanne C. "The Brave New World of Corporate Education," *Chronicle of Higher Education* 9 Feb. 2001: B10-11; James L. Morrison, "Corporate Universities: An Interview with Jeanne Meister," *Vision* July/August 2000, 11 Oct. 2000. <http://horizon.unc.edu/TS/vision/2000-07.asp> as cited in

- UNext.com is creating Cardean University, an international endeavor focusing on business education, with the University of Chicago, Stanford, Columbia, London School of Economics, and Carnegie-Mellon (www.cardean.com).⁸⁴
- The University of Maryland University College's for-profit corporation, called UMUC OnLine.com, Inc., has seen its on-line course enrollments grow from 3,000 in 1997, to 9,000 in 1998, to 21,187 in 1999, to 36,000 in 2000.⁸⁵ The for-profit arm was closed in 2001 but the University of Maryland continues to offer courses.⁸⁶

Virtual institutions

There has also been a surge in institutions offering on-line courses. According to one study, there are more than 900 institutions that offer on-line courses.⁸⁷

- The British government announced the establishment of e-University in February 2000. e-University will be a consortium of public, private, and foreign institutions designed to compete globally with the major virtual and corporate universities in the United States and elsewhere.⁸⁸
- WebCT, a leading provider of on-line course development tools, has provided on-line course support to 24,000 faculty, 90,000 courses, 3.6 million students, and 800 institutions in 45 countries.⁸⁹ In 2003, WebCT is claiming to provide on-line course materials at 2200 institutions in 80 countries.⁹⁰
- The African Virtual University was established in 1997 and was a pilot program World Bank project offering courses in Sub-Saharan Africa from 14 English and 8

Newman, Frank and Lara Couturier, *The New Competitive Arena: Market Forces Invade the Academy*. Providence: The Futures Project, Brown University, 2001, p. 26. www.futuresproject.org.

⁸⁴ "Policy for Higher Education in a Changing World: Briefing on New Providers," Providence: The Futures Project, Brown University, April 2000. p. 2. See also Data from International Data Corporation, as cited in Merrill Lynch, *The Book of Knowledge* 9 Apr. 1999: 121 which was cited in "Policy for Higher Education in a Changing World: An Update on New Providers," Providence: The Futures Project, Brown University, 2002, p. 4. www.futuresproject.org.

⁸⁵ Meyer, Eugene L. "U-Md. College Rapidly Expanding Online Education Offerings." *Washington Post* 13 April 2000, M12. Cited in "Policy for Higher Education in a Changing World: Briefing on New Providers," Providence: The Futures Project, Brown University, April 2000. p. 2. http://www.futuresproject.org/publications/new_providers_brief.pdf.

⁸⁶ "Policy for Higher Education in a Changing World: An Update on New Providers," Providence: The Futures Project, Brown University, 2002, p. 4. www.futuresproject.org.

⁸⁷ "Policy for Higher Education in a Changing World April 2000, Briefing on New Providers." http://www.futuresproject.org/publications/new_providers_brief.pdf.

⁸⁸ "Online." *Chronicle of Higher Education* 3 March 2000: A41 as cited in "Policy for Higher Education in a Changing World April 2000, Briefing on New Providers."

http://www.futuresproject.org/publications/new_providers_brief.pdf. See also, "UK eUniversities Worldwide, About us," 28 Jun. 2002. <http://www.ukeuniversitiesworldwide.com>. as cited in "Policy for Higher Education in a Changing World: An Update on New Providers," Providence: The Futures Project, Brown University, 2002, p. 3. www.futuresproject.org.

⁸⁹ "WebCT Tops 1000 Colleges and Universities With Almost 4.3 Million Student Seats." December 30, 1999 <www.webct.com/news/ and <http://www.webct.com/company/index.html>>. Cited in "Policy for Higher Education in a Changing World: Briefing on New Providers," Providence: The Futures Project, Brown University, April 2000. p. 2.

⁹⁰ Transforming the Educational Experience: WebCT Brochure, Lynnfield, Ma: WebCT, 2003. <http://www.webct.com/service/ViewContent?contentID=6205875>.

French universities.⁹¹ It has since transitioned to a private company located in Nairobi and now has 34 learning centers in 17 African countries.⁹² <http://www.avu.org/section/about/index.htm>.

- The Global Education Network originally proposed to create a for-profit consortium focused on undergraduate education in the arts, sciences, and humanities. The consortium was to bring together schools including Brown, Amherst, Williams, Princeton, Stanford, Dartmouth, and Cornell.⁹³ The consortium was not successfully formed so that it is now recruits individual faculty members and offers a degree through Charter Oak State College.⁹⁴
- The Secretary of the Army has proposed to encourage soldiers to further their education by paying for a two-year associate's degree from an accredited on-line institution.⁹⁵
- Education-related companies such as Concord University School of Law are also developing for-profit institutions. This law school is part of Sylvan Learning's chain of private for-profit universities. The for-profit ventures also include certificate programs developed by corporations such as Microsoft and Novell.⁹⁶

This trend is expected to have serious implications for the ways that higher educational facilities deliver courses in the coming decades. This shift to for-profit and on-line educational facilities will influence the types and kinds of buildings that are used to deliver educational services. This is likely to mean a shift away from relying solely on traditional campus facilities and more on nontraditional venues such as office buildings and in-home courses.

Summary, conclusions, and recommendations

This chapter provides a brief snapshot regarding the emerging trends in the commercial sub-markets. The drivers of change in commercial buildings are the technological and organizational changes that are occurring in the areas of communications, energy, transportation, nanotechnology and biotechnology, manufacturing, and materials.

These emerging trends affect all sub-markets within the commercial building market.

Changes in communications will:

⁹¹ "Policy for Higher Education in a Changing World: Briefing on New Providers," Providence: The Futures Project, Brown University, April 2000. p. 2.

⁹² <http://www.avu.org/section/about/index.htm>.

⁹³ Carr, Sarah. "Distance-Education Company Woos Bastions of the Liberal Arts." *Chronicle of Higher Education*. 28 Jan. 2000: A43. as cited in "Policy for Higher Education in a Changing World: Briefing on New Providers," Providence: The Futures Project, Brown University, April 2000. p. 2. http://www.futuresproject.org/publications/new_providers_brief.pdf.

⁹⁴ <http://www.gen.com>

⁹⁵ Suro, Roberto. "Army Considers Education as a Recruitment Tool." *The Washington Post* December 10, 2000: A1. as cited in *Policy for Higher Education in a Changing World: Briefing on New Providers* Providence: The Futures Project, Brown University, April 2000. p. 2. http://www.futuresproject.org/publications/new_providers_brief.pdf.

⁹⁶ "Policy for Higher Education in a Changing World: Briefing on New Providers," Providence: The Futures Project, Brown University, April 2000. p. 2. http://www.futuresproject.org/publications/new_providers_brief.pdf.

- Affect the ways in which office workers conduct business and the amount of traveling they do.
- Increase the amount of telecommuting, untether workers from the workplace, increase the number of freelance workers and businesses, and effectively eliminate the need for large complex offices.
- Influence the ways in which restaurants organize their kitchens and prepare meals.
- Accelerate the shopping cycle making goods more readily available to customers, increasing demands on warehouses, and causing the elimination of middle firms.
- Improve the quality of healthcare by providing preventative, proactive healthcare through networks of linked information sources about patients and their conditions.
- Offer increased options and benefits to busy travelers trying to keep in touch on a global scale.
- Provide new and expanded opportunities for students to advance their education through on-line courses.

Changes in the production, distribution, and control of energy will:

- Reduce energy consumption at the office while promoting more flexible and personalized workspaces.
- Provide restaurants with information needed to better manage their kitchens, refrigerators, and overall operations.
- Allow retailers to display goods more profitably and create more comfortable shopping experiences.
- Provide hotels, warehouses, hospitals, and educational facilities with abilities to better manage their energy usage through greater information tools and technologies.

Changes in transportation will:

- Significantly shorten the commuting times for office workers.
- Increase the options and flexibility for retailers who will rely even more heavily on warehouses for final goods delivery.
- Expand offerings in both restaurants and grocery stores to more “take-away” items that ease the time pressures busy customers face on a daily basis.
- Improve patient healthcare by transferring difficult cases more immediately to larger regional medical centers.

The advent of nanotechnology/biotechnology will:

- Improve healthcare by providing more specialized tools to handle difficult procedures.
- Improve the healthcare technologies available to patients through more compact, more sophisticated, and easier to use diagnostic equipment and treatments.

Changes in manufacturing will:

- Streamline the process and shift more of the actual product work to warehouses in an effort to speed up supply lines.
- Create more flexible product lines, adapting more easily to changing consumer whims and making retailers even more price competitive.
- Make it possible to mass customize buildings.

Advances in materials will:

- Allow for the development of more resilient products to improve overall operating efficiencies in the office, education, healthcare, and warehouse sub-markets.
- Create materials that will allow buildings to be stronger but lighter and have dynamic properties that can change the ambiance.

We have discussed a lot of potential changes. Some of these will occur in a 10 to 20-year span though others will take much longer. Some will die aborning. Other trends that we have not anticipated will appear on the scene. The important points to take from this chapter are that in the future:

- Buildings will be structurally different.
- Buildings will be built using different processes.
- Building environments will be very different.
- Current uses of buildings will change dramatically.
- How we interact with buildings will change.

Chapter 3 Decision-Making in the Commercial Building Segment

So, who decides on how a building is to be built? -- Well, that's easy, said Alice, the owner decides! The owner hires an architect and builds the building.

So Alice, you're saying it is not just the owner but that the architect has some say as well? -- Well, yes, and maybe an engineer or two.

Alice, what about the national retailer who leases space from the developer at the new mall? Who decides what is in that building? -- Hmm, well, the retailer decides how the space is arranged, so the retailer must have some say as well!

What about the person who does the financing? -- I guess that person can say how much money there is to spend.

So, who decides whether we can have high efficiency lighting and a high efficiency chiller? -- I dunno, said Alice, I figured that it would be the lighting designer and the engineer. But maybe it's more complicated than I thought.

Most of us are somewhat like Alice. Who makes decisions about buildings seems an easy question until we begin to examine the issues. The owner is sometimes the right answer, but sometimes the person or firm that holds the title to a property and the people who make the decisions are quite different. In this, chapter we examine some of the factors that determine or influence who decides.

The decision makers

Who the decision makers are can vary greatly from building to building. Lutzenhiser, *et al.*⁹⁷ have pointed out that there are at least five categories of decision makers: the capital providers, the developers, the users, building professionals, and community regulatory interests. In the rest of this chapter we will explore how these different players are involved with decision-making.

Capital providers

There are many ways to finance a building. How a building is financed depends on who is constructing it and why.

A company that is building space that it wants to occupy has several options. It can invest its own money directly. It can go to a financial institution such as a bank and borrow money. It can use capital that is raised from investors.

⁹⁷ Lutzenhiser, Loren, Nicole Woolsey Biggart, Richard Kunkle, Tom Beamish, and Thomas Burr, 2001. *Market Structure and Energy Efficiency: The Case of New Commercial Buildings*. Berkeley, Cal.: California Institute for Energy Efficiency, University of California.

Regardless of which approach is taken, there is always some level of accountability that must be met. For a company that is investing its own money, the owners, investors, or board of directors will exercise some decision-making authority about whether the investment should be made and the level of investment. These decision makers will set limits on the size and the amenities associated with a project. Depending on the size and the importance of the project they may become directly involved.

If a firm constructing a building for its own use approaches a financial institution, the financial institution representatives will assess the risks associated with loaning money for construction. They are likely to examine whether the proposed building is in line with the client's needs, whether the building is a good value in itself and in the larger market for buildings, and whether the client will have the ability to repay the loan. By setting a value on the loan and imposing other financial conditions, the financial institution sets limits on the size and the amenities associated with the project. In order to spread the risk, the financial institution may also bring third parties to the table who may impose additional conditions on the project.

If the firm uses outside investors, the outside investors will assess the risks and rewards for themselves and set limits on the size and amenities.

Developers often build buildings for sale to others. When this occurs, a developer usually has a client, although some buildings are built on speculation. The developer's profit is the difference between what it costs the developer to construct the building and the value for which the builder can sell it. The builder may be investing the builder's own money but may also be using money from a group of investors. In some instances a builder may borrow money from a financial institution to finance the construction of the building.

A building built for a client will be built to the client's specifications to the degree that a client can demonstrate the ability to purchase the building. If the building is being built on speculation for a group of investors, the financing for the building is likely to be a reflection of the investor's assessment of the market with respect to the kind, size, and amenities that are in demand in the marketplace. A builder constructing a building on spec may complete only the shell of a building until there is a client for the building. This minimizes the investment in the building and makes it possible to tailor the building to the client's needs, tastes, and budget. There are two important points. The objective for building speculative buildings is to minimize cost. The investors will set limits and these limits will influence what can be placed in the building.

A third type of building construction involves those built for investors who then lease the space or hire a management firm that then leases the space for them. These investors are purchasing properties for investment purposes. Some of the largest insurance companies and pension funds (e.g., Calpers and TIAA/CREF Teacher's Insurance Annuity Association/College Retirement Equities Fund) own portfolios of property that have been developed for them. As an example, TIAA/CREF has a substantial investment in Mall of America in Minneapolis (See Chapter 2, p. 23). Large investors like TIAA/CREF are savvy about the amenities that should be in a building. In talking with developers who have worked with these types of investors, they point out that investors can be very much involved in setting budgets, approving major change orders, and monitoring construction.

There are several important points to be made about financing. The first is that the financing sets the limits for the project. Once established, budgets are usually fixed. Establishing the budget for the investment is a time consuming process involving substantial negotiation and contracts that the investors, developers, or other parties in the negotiation generally don't want to revisit.

The importance of fixing the budget cannot be overstated. Changes occur in all projects. However, changes are almost always implemented within the estimated construction costs and any contingency funds that are established as part of the initial budget. The implication of this is that if one decides to install energy efficient equipment after the budget is determined and the equipment costs more, then savings have to be found elsewhere in the budget. A second implication is that changes to a project resulting from unanticipated factors or changes that the owner or developer decide upon may result in changing equipment for less costly equipment or removing some types of features such as control systems. We have estimated that this "value engineering" occurs in 30 percent of projects.⁹⁸

An additional point about financing is that budgets and financing are usually established very early. The decision to finance a project is often based on a sketch of a project washed with water colors, per square foot estimates of the construction costs based on the amenities that are proposed, and a business plan containing an analysis of the square footage, estimates of revenues, costs, tax implications, payback, etc. The budget is established long before there are detailed design documents, energy cost analyses, or specifications for equipment. If the estimated costs do not include the cost of efficiency, for example, then the efficiency items will only be installed if they can be squeezed into the budget at a later time.

Thus, financing enters into the decision-making in three important ways. (1) Decision makers place value on the features they want in a building when establishing a budget or when hewing the budget once the project is underway. In order to include energy efficiency as one of these values, investors must understand energy efficiency in terms that are meaningful to them. This might be the asset value of the building. It might be the reduction of risk. It might be the comfort of a tenant. (2) The budget establishes limits to the amenities that are added to the building. (3) The commitment to energy efficiency must be made early.

Developers

Developers now organize much of the construction of commercial property. This is particularly true in large projects. However, smaller owners wishing to build a commercial building may still engage an architect and a contractor to design and construct a building. However, they are just as likely to engage a developer who presents a turnkey package.

Organization of property development companies

Property development involves a range of services including identifying, financing, acquiring, planning, and managing the development of property. Property developers may

⁹⁸ ADM Associates and TecMRKT Works, *Nonresidential Remodeling and Renovation Study*, Sacramento: California Energy Commission, March 2002.

develop properties for their own firm, with the intention of selling to others, may develop properties for firms that want to own their own buildings, or for other firms or individuals that want to own property to lease to others.

Property development has become big business. As we shall see later, a few relatively large office developers may develop as much as 70 percent of the office space that is built in this country annually. Some property development firms have construction arms that design and build commercial buildings while others use outside construction firms. They may construct buildings for their own firm and/or for others. The construction side of a development firm is usually focused on new construction. Ironically, when undertaking remodeling and renovations for the firm's own property management operations, a development firm typically uses third party contractors rather than their own internal contracting operation. Within the development or construction function, some firms may have an officer responsible for technology whose job is to identify and evaluate new and promising building technologies.

Most development firms also own property. There may be an entity within the firm that deals with property ownership issues such as legal issues, taxes, etc. Development firms may also have separate property management arms. The property management arm is usually responsible for leasing and maintaining property. The part of the firm that "owns" the property may use its own property management arm or contract with another firm to do the management. Firms do not always have a property management organization in an area where they own property and often find it cost effective to have the property managed by others.

Property management is a specialty in and of itself. Full-line property managers are responsible for recruiting tenants; managing the day-to-day operations of the building; maintaining the building; keeping equipment functional; cleaning the building; and managing the utilities, security and other functions. In the past, property managers contracted for many of these services or managed in-house staff to complete these tasks. Increasingly, these activities are being outsourced to companies that are bundling these services into more comprehensive packages. Large firms that own buildings may also use the services of commercial property managers.

Some commercial property firms have parts of their organizations that do asset management. The asset management arm of the firm is usually engaged in redeveloping property. Redevelopment of an existing building may mean anything from a simple change of management to a full "gut rehab."

Typically asset managers identify properties in high potential locations that are undervalued because they are due for an update, they have a high vacancy rate, or they have the wrong mix of tenants and/or poor management. Asset managers purchase property and address the issues affecting the value of the property by changing the management, updating the building, decreasing the vacancy rates and/or changing the tenants. The property is then sold at a premium relative to the purchase price. Such transformations may take anywhere from three months to three years. Some asset management organizations may redevelop a property for another company under a fee arrangement.

In addition to the lines of business identified above, some development firms have real estate leasing operations. These operations may be responsible for leasing the property owned by the firm as well as providing leasing services to other property owners.

Development firms can be national, regional, or local. The largest development firms are national organizations. Development firms will often have a regional or sub-regional organizational structure that mimics the structure of firms at the national level.

Thus, large commercial property developers are really multi-line businesses. The different operations may be structured as separate businesses within a holding company structure or as different lines of business under a series of vice presidents. Each firm is different. Usually the various branches of the firm are viewed as separate profit centers. Within the firm or holding company, these branches may compete with each other for investment capital. Thus, a facility engineer may have to demonstrate that building improvements have a return that is competitive with other opportunities to invest capital such as building another building or expanding property management services. Firms scrutinize opportunities very closely and there may be no particular bias, other than return, that drives selection.

Developer investment strategies

Developers and the organizations within a development firm may have different investment strategies. The importance of investment strategies is that they establish a framework within which decisions about buildings and changes to buildings are made.

The types of investments in buildings that a developer will consider may depend on investment strategy. In a buy and hold strategy, the investor's focus is on buying buildings and holding them with a goal of realizing both capital gains and income from rentals and leases. An alternative strategy may be capital gains oriented. A firm may purchase a building that is partially leased and in need of refurbishing, refurbish the building, lease it, and then sell the building realizing the capital gains. The goal is to turn the property around quickly ("flip it") to achieve the gain. A third strategy is to minimize total investment while seeking as much revenue as possible.

Alternative investment strategies have different consequences for energy efficiency improvements. In a buy and hold strategy, the owner may be looking for ways to add perceived value for people leasing space in buildings especially to the extent that that can increase the return on space. Such a strategy also requires high occupancy rates and the ability to attract or retain customers. In this strategy, high performance lighting may be a way of attracting and retaining someone on a lease. A firm with a buy and hold strategy may be willing to consider efficiency investments with somewhat longer paybacks.

A capital gains oriented strategy might be used by an organization doing asset management. The firm redeveloping a building might only make investments in equipment and amenities that enhance the value of the building for potential buyers or only consider investments that have a payback that is less than the period that the developer intends to own a building.

Strategies appear to be associated with firms or parts of organizations within firms. Firms structure and organize themselves to make the most of the strategies that they have chosen. Firms appear to follow strategies over fairly long periods of time. Investment

strategies are largely the province of high-level managers. These managers tend to focus on them rather than the details about buildings such as energy efficiency. Strategies are probably driven more by the preferences of owners and managers, tax laws, and the expertise of the firm than by economic cycles.

There are at least two key points with respect to investment strategies and the transformation of energy efficiency markets. First, developers, as represented by the investment managers, are interested mostly in return on investment. Large developers /owners have staff to whom they delegate the details such as calculating return on investments for such things as energy efficiency projects. Managers pick and choose among the alternatives. In terms of promoting energy efficiency, detailed information about cost savings targeted to investment managers is likely to go unread. On the other hand, targeting managers with information that favorably compares a range of benefits from energy efficiency investments to other investments may get their attention. There is an information market place and the users of information are more likely to attend to information that meets their needs.

Secondly, developers have general investment strategies. These strategies set the parameters within which investments are made. The investment strategies encompass a much broader set of issues than energy efficiency. There are many opportunities to invest money in buildings. Among other things, one can upgrade a lobby, increase the speed of the elevators, buy improved maintenance equipment, upgrade space for a tenant, invest in energy efficiency, or buy another building. Each option represents an opportunity and a return on investment. If an important criterion is to maintain a 35 percent or greater return on investment opportunities that yield less than this are likely to go unfunded. Thirty-five percent is at the higher end of a continuum but there is some threshold value below which decision makers will turn to other opportunities.

Current market transformation efforts are generally focused on trying to convince users to make changes on the basis of energy savings. While useful, such arguments are not very convincing to developer-managers since those arguments do not address the issues in which they are most interested. As currently structured, it is unlikely that energy related market transformation efforts will impact the broader investment strategies. What market transformation efforts can impact is what is included in the calculation and how the return on investment calculation is done for energy products and services. For instance, if the focus includes asset value and productivity, investors and developers may view the investment more favorably than if the decision is based on energy savings.

Users

The user or users of a space or a building are critical to decisions about the amenities that are to be found in the space. If the owner uses the space, then the relationship to decisions and amenities is quite clear. It is often assumed that tenants have much less to say about the amenities that are found in a space or building than owners. This section mostly focuses on tenants as users.

Decisions regarding owner-occupied buildings are heavily influenced by the needs and demands of the owners. In contrast, decisions regarding how space can be used and

modified in leased buildings are subject to negotiation between the tenant and the owner or the owner's representative.

The degree to which a tenant in a lease situation controls amenities can range from constructing a building of the tenant's design on a plot of leased ground, a ground lease, to accepting a space and the amenities within it more or less as is. The equivalent of a ground lease in a retail setting is being able to modify anything between the floor and ceiling and within the walls of a leased area. The degree to which a tenant can control the design and features of a space is largely a function of what the tenant is willing to pay. The owner may place some constraints on the external appearance for reasons of consistency, for example, within a mall or group of buildings. A landlord sued a major retail client in Madison, Wisconsin, about ten years ago because the retailer repainted the exterior of a big-box store in the retailer's colors. Apparently, the lease was not specific on this detail.

The structure of the lease depends on tenant requirements and whether the owner or the lessee is to meet the requirement. A tenant may have a complex design that incorporates the image that the tenant wants to project to the public or special requirements that the tenant needs to conduct business from the space. These designs and requirements may include electrical and mechanical requirements such as raised floors in computer rooms, special air conditioning or air filtering units, and lighting such as indirect lighting in areas where employees are using computer screens. The tenant may have designers and contractors who design and build the space to specification. Alternatively, the owner may build to suit or each party may be responsible for parts of the construction. As an engineer for one national retailer told us not long back, "we haven't met an owner who would not let us do what we need to do as long as it is in the lease."

Although we do not have data to demonstrate this, it appears that lessees are more likely to do their own design and construction if they require complex changes, particularly if they are brand related. In other cases, owners may bring the space to a predetermined standard and the tenant then adds their own fixtures and signage.

The lease will spell out the special conditions as well as who is providing the designs and doing the construction. It may also specify who is to dismantle features that are incorporated into a space when the feature has reached its useful life or when the lease is terminated. For instance, the lease may specify that data cable should be retrieved from the plenum upon termination of the lease. The lease will clearly spell out the cost and who is to pay for the improvements and for the operation of the improvements.

The assumption is often made that the costs of energy efficiency upgrades are a cost to the property owner and that the benefits accrue to the lessee who pays the energy bills. It is further assumed that landlords are reluctant to make efficiency improvements. The reality is somewhat different than this.

As noted above, leases are always open to negotiation. The conditions of the lease may vary with conditions in the market or even with the nature of the space involved. In tight markets, the tenant may get a less advantageous lease. When energy costs are volatile, the tenant may be required to pay for energy costs above a certain threshold. When competitive space is widely available, the terms of the lease may favor the tenant. The terms of leases within the same building may vary quite substantially from tenant to tenant.

The important point is that one cannot generalize about who may be paying for the energy or other amenities in a lease.

Who pays for the energy may be influenced by other factors including the relationship of the lease space to the structure of the building. In large structures with centrally conditioned air, the “landlord” is likely to pay the bill for the air conditioning while lighting and plug loads may be separately metered and may be paid by the tenants. What that means is that the landlord builds air conditioning energy costs into the lease along with a threshold above which the tenant pays the costs on a per square foot basis.

It is not unusual for a leased office or retail space to have several accounts with the same electric utility. As the configuration of the space changes based on tenant requirements through the years, circuits are divided and meters added to account for the services supplied to the space.

In smaller structures with package units or other types of space conditioning, there may be a one-to-one association between the space conditioning equipment and the lease space. In these cases, the lessee may pay directly for the energy associated with all uses within the space.

There are three basic types of leases:

- A gross lease in which the landlord pays for everything
- A fixed base lease in which the landlord pays for the energy costs to some specified level (the base) after which the tenant is responsible for the energy costs
- A net lease in which the tenant pays for everything

In the case where the landlord pays for everything, the return from energy savings investments go entirely to the landlord. In the case of a fixed base lease, there is a threshold above which the lessee pays the additional cost of energy. If an energy savings investment lowers the energy cost per square foot well below the threshold, then the owner receives direct benefits from the amount of the cost reduced below the threshold and the tenant benefits from not having to pay for the cost of energy above threshold. If the costs are sufficiently reduced under the base, the landlord has incentives to improve energy efficiency. In addition, Jewell points out that energy efficiency improvements can increase asset value and that this, in turn, is of substantial benefit to the landlord.⁹⁹ Finally, if the lessee pays everything and the lease is of sufficient length, it is to the lessee’s advantage to make efficiency improvements.

It is often argued that split incentives are a barrier to promoting energy efficiency in the commercial sector. As noted above, there are many lease situations where the capital costs and the utility operating expenses are not split between owners and lessees but are assumed by the owner or the lessee. Later we will see that lessees occupy 24 percent of nongovernmental spaces and 23 percent of nongovernmental square footage. If we remove from consideration leases where the capital costs and the benefits mostly accrue to the same party, split incentives may be an issue in 10 or perhaps 15 percent of commer-

⁹⁹ Mark T. Jewell, “Making Energy Efficiency Work in Multi-Tenant Buildings,” in the *13th National Energy Services Conference Proceedings*, 2002. Jupiter, FL: Association of Energy Service Professionals, 2002.

cial premises or square footage. If this is true, the notion that split incentives are a significant barrier to promoting energy efficiency should perhaps be categorized as an urban myth.

Clearly, owners who are going to be users play an important role in decision-making about new construction. Lessees play an important role as well and may be a more important decision maker than the person who physically owns the structure in some lease situations. This is especially true in the retail market where lessees want their space to reflect the image that they want to convey and/or where operational requirements are important. Lessees may be important decision makers in high-end office environments as well.

Building professionals¹⁰⁰

Building professionals clearly play an important decision-making role with respect to new construction. The important questions are what roles and how much of a role do they play in making decisions. One way to think about this is to ask how professionals are organized to deal with projects. It is helpful to think in terms of three models.

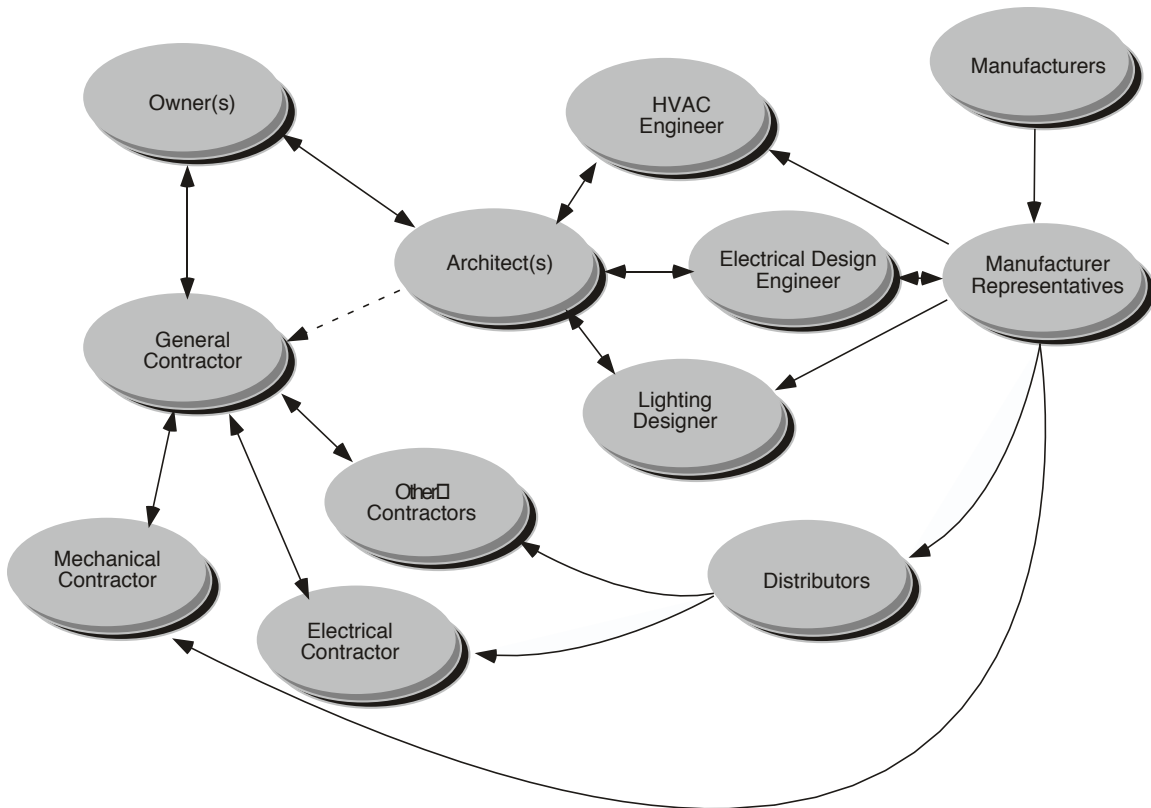
- The plan/design/build model
- The design/build model
- The collaborative model

The traditional architect driven plan/design/build model

Figure 7 illustrates the traditional architect driven plan/design/build model. In this model the owner engages the services of an architect through personal contacts or through a competitive solicitation. The architect is responsible for developing a concept and, upon approval of the concept, managing the development of the detailed plans and specifications. Depending on the size of the firm and the range of expertise, the architect will either use internal expertise or engage outside consultants to develop the detailed designs and specifications for mechanical, electrical, safety and security systems, etc.

With drawings and specifications in hand, the owner solicits bids from contractors to construct the building. The bid process may call for bids from general contractor teams including the mechanical and electrical subcontractors and others, or the general, mechanical, and electrical contracts may be bid separately.

¹⁰⁰ Reed, J. H., et. al., "Market Segments in the Commercial Remodeling and Renovation Sector," *Proceedings of the ACEEE Summer Study*, Washington, D. C. 2002. Reed, J. H., et al, *The Structure and Operation of the Commercial Building Market*, *Proceedings of the ACEEE Summer Study*, Washington, D. C. 2000. Reed, J. H. et al, *PG&E Energy Center Market Effect Study*. San Francisco: PG&E, 1998.



Source: TecMRKT Works. 1997

Figure 7 General model of the actors in a traditionally designed building

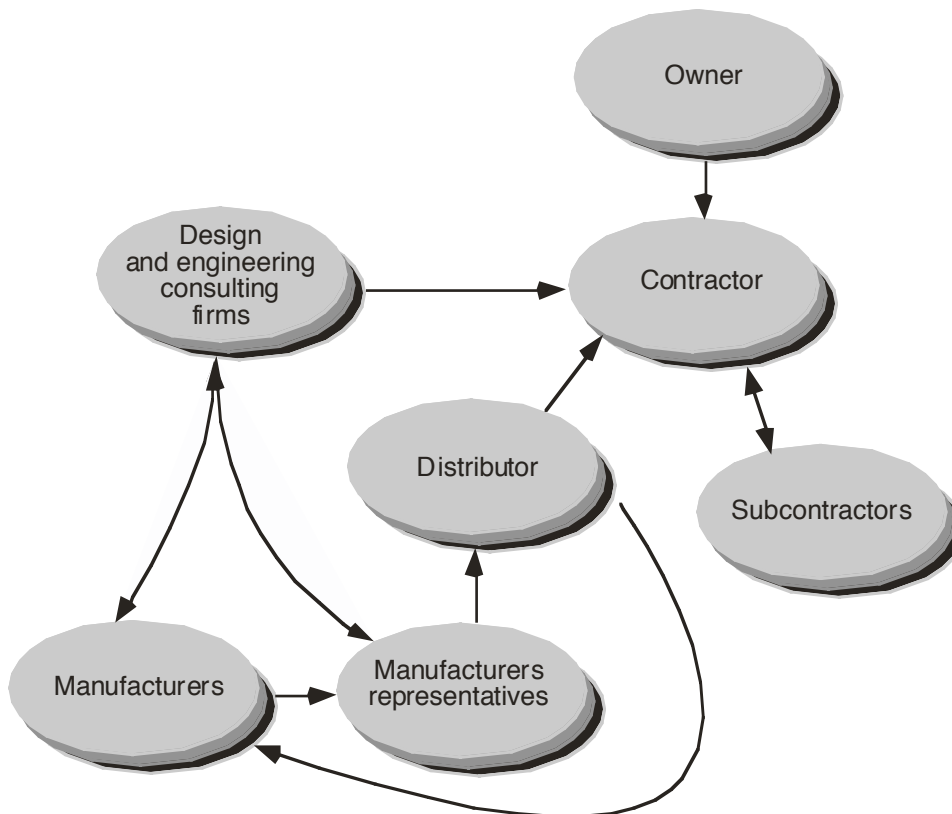
One of the theoretical advantages of the traditional plan/design/build model is that design issues are worked out in advance and presumably the solutions are integrated. In reality, the level of the integration is highly dependent on the ability of the architect to manage the work team and the degree to which the general contractor is able to manage the construction team. The level of integration can range from full partnership in the design process to fairly independent work by each consultant. Well coordinated teams are likely to produce buildings that are more efficient, provide customers with value, and provide greater user comfort than are teams that function less well together. The level of integration is partially a matter of the owner's willingness to pay for the services and partially a function of the choice of actors, the actors' communication skills, and the functioning of the team leaders.

The number of actors will vary. For instance, the lighting designer may be a member of the architectural firm, may be a consultant as shown here, or may work for an electrical design engineering firm.

In the traditional plan/design/build model, the key decision makers are the owner, the architect(s), and the consultant designer(s). These actors make the key decisions about footprint, orientation, facade, equipment, etc. The general contractor and others play much less of a role in efficiency, comfort, and owner value issues.

The design/build model

During the past 15 to 20 years an increasingly greater proportion of new construction activity has been organized using the design/build model. (See Figure 8.) A key advantage of the design/build model is speed. In the traditional approach, the architect completes plans before dirt is moved and concrete poured. Design/build is devel-



Source: TecMRKT Works, 1997

Figure 8 Design/build model

oper/user/contractor driven. Design and construction are completed on parallel tracks with an attendant savings of elapsed time. Later stages are being designed as earlier stages are being put into place.

Design/build relies heavily on the contractor's experience and knowledge. The contractor builds a shell on speculation or the developer/owner contracts directly with the contractor for completion of the building.

The contractor may use the same basic structural designs repeatedly varying them in a rectangular shape, a v-shape, or a y-shape depending on the site and the developer's or owner's wishes. The contractor either has internal staff who do the layout and set the specifications, or the contractor obtains those services from outside firms. The contractor uses the same subcontractors and repeats equipment selections used in earlier projects. The contractor's employees and the outside design firms may rely on distributors and the distributor's manufacturer representatives for product knowledge. Much of the work is formula driven and the level of analysis and integration not very high.

The contractor working with the owner, user, or developer may arrange the structure on the site to facilitate access, parking, drainage, and other features. The contractor may engage an architect who “paints” a facade. A planning consultant may be engaged to lay out internal spaces acceptable to the needs of users. The architect may be brought back to provide design details for key spaces, such as the foyer, and specifications for finishes in other areas. The design and layouts may be sent electronically to the electrical engineering and mechanical engineering firms who provide the electrical and mechanical layouts or may be given directly to mechanical and electrical contractors who design and install the systems. The layouts are done with minimal detail. The process is often one where professionals are used serially rather than in parallel.

In the design/build environment, it is the developer or user — or their representatives in the person of the property manager, facility manager, or design staff of the firm — that is the key decision makers. Generally, the contractor responds to their requirements. The contractor is also a key decision maker. The contractor can be motivated to build more efficient buildings if the efficient designs give the contractor an advantage in the market place.

The collaborative process model

There is a perception that buildings built using traditional and design/build models suffer integration and quality problems. Integration and quality problems are perceived to stem from the fragmentation of responsibility, design processes that are more serial than parallel, and inadequate communication between disciplines during design and construction. It has been widely recognized that “bad” buildings result from the lack of teamwork and integration of product by designers and builders.

In the traditional model there is potential for conflict among the design consultants and the architect as well as among the architect, the general contractor, and the subcontractors. In a design/build environment, there is potential for conflict between design consultants and the general contractor.

The conflicts often arise when individual systems requirements are not communicated fully and clearly enough at the various stages of the design process, and the disciplinary teams then design systems that meet some but not necessarily all of the requirements. For example, the architect and space planners may not communicate information about the utilization of space, and the mechanical engineer may not communicate the physical space requirements for HVAC components or airflow. The result can be conflict couched in disciplinary values. The architect defends the aesthetic. The space planner defends the organization and efficiency of the space. And, the engineer puts forward arguments about the thermal comfort of users and indoor air quality.

The crux of the issue has to do with the amount of additional design work required to resolve the conflict. The margins in contracts are not large and the profits in design and construction can be quickly dissipated if too much redesign is required. The resulting solution is likely to be based on minimizing and spreading the costs among the parties rather than one that provides optimal functionality, comfort, aesthetics, and efficiency.

The collaborative process model has been developed as a way of addressing integration and quality issues. In the collaborative process model, owners engage the services of a

team representing the range of disciplines needed to construct a new building — architects, design consultants, and contractors — rather than separately engaging the actors. The members of teams have long-term agreements to work with one another on projects and to bid as teams.

The collaborative process involves building teams that work well together, that stress and build performance, and that utilize common communication and planning tools to make the design and construction process function smoothly. Collaborative process teams differ from partnering arrangements that may be agreements to work together with little focus on interpersonal dynamics and design tools that allow the partners to work together more productively and efficiently.

From the perspective of transforming the energy market, collaborative teams are potentially an ideal mechanism. Their focus is systemic and their goals are oriented to achieving an “optimal combination of cost, quality, function, scope and time” to meet the needs of clients.

Community regulatory interests

In this study we have not explored the role of regulatory interests in detail. We would include within the definition of regulatory interests state and local codes, standards, certification, state and local code officials, standard setting bodies, and certifying organizations. Although not necessarily regulatory, the role of unions might well be included in the examination of community interests.

Building codes are generally adopted at the state or local level and enforced at the local level. Usually they are based on model codes or standards such as the standards developed by the American Society for Heating, Refrigeration, and Air conditioning Engineers (ASHRAE). Codes generally strike a balance between leading edge energy performance and cost.

It is clear that codes and standards are effective in increasing the energy performance of buildings. For instance, a recent study in California showed that buildings are mostly meeting the Title 24 standards, the energy efficiency code for California.¹⁰¹ The evaluation of whether designs will meet the standards is typically delegated to the engineers.

Findings from California studies suggest that public construction typically exceeds code to a greater degree than does private construction that generally meets code.¹⁰² There may be two reasons for this. Much of the public construction is in the educational sub-market. Decision makers, school superintendents and school boards, in that market are quite cognizant of the effects of long-term operating costs and tend to build to minimize them. Public funding for projects often comes from the sale of bonds. Because of the time involved and a decision process that may require a voter referendum, there may be a tendency to insure that the capital derived from bond sales is adequate to the need.

¹⁰¹ RLW Analytics, *Non-Residential New Construction Baseline Study*, Sonoma, CA: RLW Analytics, July 1999. http://www.calmac.org/warn_dload.asp?e=0&id=1629.

¹⁰² *Ibid.*

The degree to which codes and standards are effectively enforced is less clear. In the case of California's Title 24, compliance is associated with the filing the Title 24 paper work with the permit application. Evidence suggests that 85 to 90 percent of buildings exceed Title 24 performance standards.¹⁰³

Regional and national developers and builders frequently hire local architects and engineering firms to serve as liaisons with local code officials. The local architects and engineers provide advice to the outside architects and engineers on how best to make plans consistent with local practice and then deal with local code officials.

There is evidence that codes and standard training is important for both officials and those who design buildings to code. In California, many designers use rules of thumb and work with consultants who evaluate whether the designs meet the Title 24 standards. Designs that do not meet the Title 24 requirements are often tweaked by engineers, who add insulation, change lighting specifications, add controls, or make other changes to bring a design into compliance. Least cost changes are implemented first to achieve compliance. It is unlikely that this tweaking process would result in major changes to a design.

Networks — paths of influence¹⁰⁴

Networks and their importance in social life have been discussed in the academic literature for more than 80 years. The “conventional wisdom” in modern life is that mass communication drives the penetration of ideas and products in the market place even though there is clear evidence to demonstrate otherwise.¹⁰⁵ Mass communication has its effects, but studies have consistently demonstrated that it is interpersonal ties and networks that are the key to the widespread acceptance of new ideas and products.

The study of networks is especially critical to developing an understanding of the ways in which buildings are designed and completed.

- Building professionals and developers are clearly linked in social and professional networks.
- If we believe the literature, those networks are potentially among of the most effective channels for communicating with building professionals.
- Our communications with building professionals and owners have tended to rely on broadcast methods.
- If we understand how building professionals and developers are linked and how communication flows, we can switch from broadcast methods to the more effective methods of spreading information by contagion.

¹⁰³ *Ibid.*

¹⁰⁴ Reed, J. H. and Andrew D Oh, “Examining Networks of Building Professionals, Developers, Owners and Contractors in the Commercial Building Sector,” *Proceedings of the International Energy Program Evaluation Conference*. Seattle WA: IEPEC August 2003.

¹⁰⁵ Rosen, Emanuel, *The anatomy of buzz: how to create word of mouth marketing*, New York: Doubleday-Currency, 2000.

- If we understand the linkages and how communications flow among building professionals, we can identify the need for and create additional weak ties to increase the flow of information.
- We can also develop proactive strategies to create networks to increase the efficiency with which information is spread.

An example of networking analysis

Our understanding of the commercial buildings market would be greatly enhanced if we could analyze networks of building professionals and developers to see who interacts with whom and what the structure of the market might be. To demonstrate the potential of network analysis, we used the F. W. Dodge Player's data for 2000 and 2001 for the State of New Jersey. The Player's data contains information about active projects in various stages of completion. Projects range from those that have just been permitted to those that are in the final stages of completion. The Dodge data capture all projects over \$100,000 and as many projects under \$100,000 as have been identified. According to McGraw Hill, the Census Bureau uses the Dodge data and has audited the projects and found that while not all projects are included, the Dodge data captures 95 percent of the value of all projects. McGraw Hill claims that the actual captured value is closer to 98 percent.

The analysis identified 2,100 cliques of three or more. A clique is made up of people or, in this case, firms, where every member works with every other member. We found 20 cliques where 8 or more firms referenced each other. In addition to members central to the clique, there are firms that may relate to one, two, or a subset of the members of the clique. Table 9 shows the size and count of cliques greater than three.

The Limited brands

We examined two cliques in order to show how networks can be used to enhance our understanding of the commercial buildings market. The first is the Limited family of companies: Lerner of New York, Limited, Limited Too, Limited Bath and Body Works, Victoria's Secret, and Lane Bryant.¹⁰⁶ Retail stores for these companies are found in many mid to upscale shopping centers and malls in this country.

Table 9 Number of cliques and number of players in the clique

Number of players in clique	Number of cliques by size
14	1
13	1
12	1
11	1
10	1
9	3
8	13
7	30
6	75
5	145
4	321
3	1500
Total cliques	2092

¹⁰⁶ Limited Brands sold Lerner New York in 2002 and Lane Bryant in 2001. Since this analysis was based on 2000 and 2001 data, stores built for Lerner and Lane Bryant would still have been associated with Limited Brands. Limited Too was a spin-off from the Limited Brands in 1999 and appears to continue to use the same architect and engineering firms that it used while part of Limited Brands.

The analysis of the Limited group is constrained by the fact that we are using data for New Jersey in 2000 and 2001. Analysis of data for another geographic region or larger area might result in a slightly different picture because the local players might change or because additional architectural or engineering firms might be identified. Nonetheless, we believe that the basic configuration is correct.

The network diagram for the Limited Group is shown in Figure 9. In this diagram, the Limited Group is identified as node 27 in the middle of the network. The Limited Group is defined as any of the retail firms under the Limited umbrella that developed retail space in New Jersey. Node 27 is the “center” of a series of nodes — 24, 25, 26, 28, 29, 30, 31, 35, and 36 — that represent the architects, engineers, and contractors who supported the construction of the Limited Group in New Jersey. The names, node numbers, and location of these firms are found in Table 10. The firms highlighted in gray form the “Limited Group” clique.

Table 10 Identifiers for selected nodes in the Limited Group Network

Node number	Company	Company type	Location
6	Fisher	Developer	NY
7	Simon Property Group	Developer	IN
8	Highland	Engineer	NY
9	Eipel	Engineering	NY
13	Oliveri	Contractor	OH
19	Elite Retail Services	Contractor	FL
22	Kravco	Developer	PA/NJ
24	Doerschlag	Architect	OH
25	Retail Design	Design	OH
26	Engineering Support Services	Engineer	OH
27	Limited Group	Retailer	OH
28	Cline	Architect	OH
29	Shremshock	Architect	OH
30	M Retail	Engineer	OH
31	HBK	Engineer	OH
34	Gap	Retailer	CA
35	Valco	Contractor	PA
36	Provini	Contractor	NJ
37	Designline	Construction services	NJ

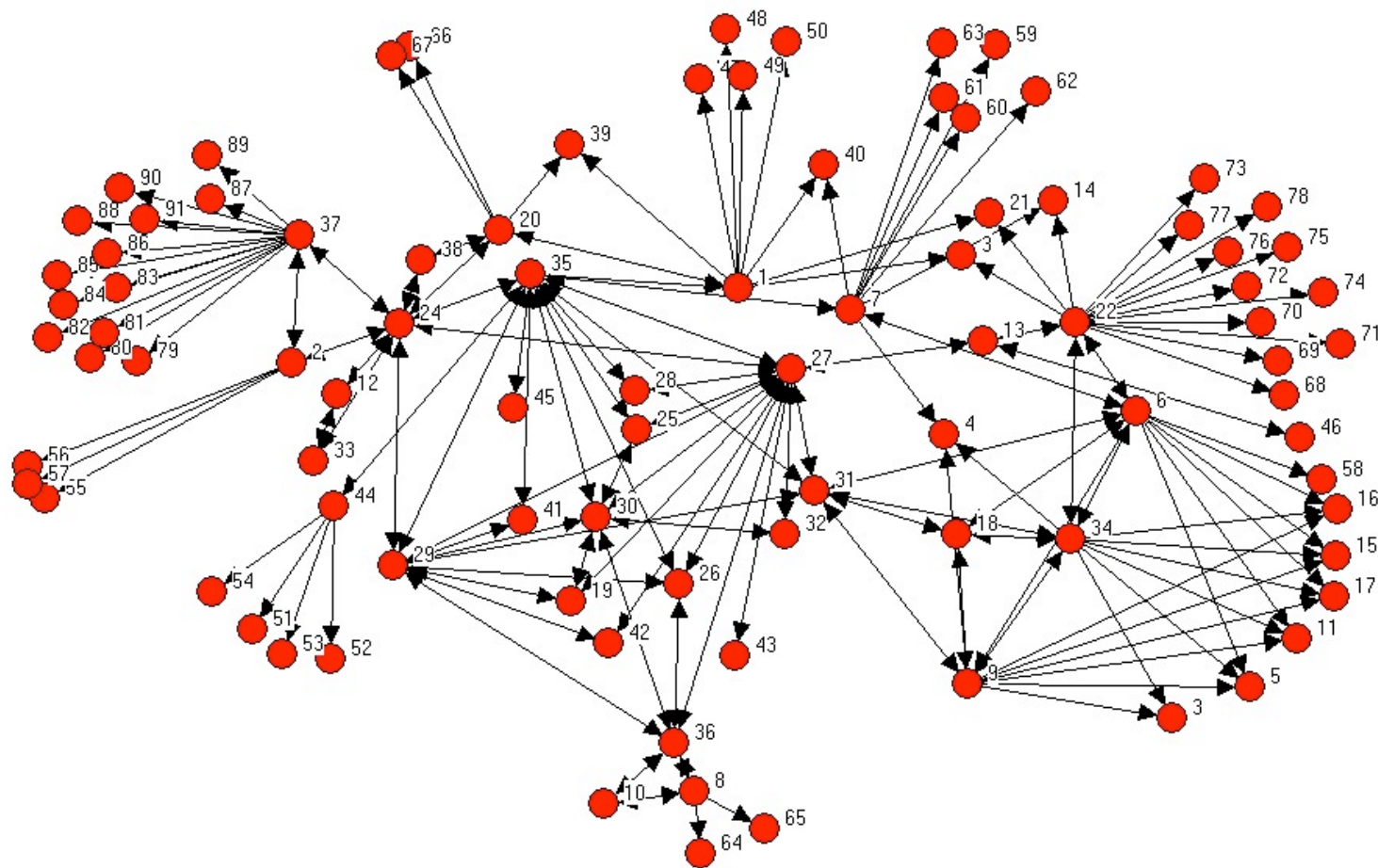


Figure 9 Network Analysis of the Limited Group based on 2000 - 2001 New Jersey data

Nodes 35 and 36 appear to be “local” contractors. The remainder of the players in the clique are architects, engineers, and retail engineering groups who do the design for the “Limited Group” in its store development efforts. For the most part, these firms are physically located geographically close to the Limited Group’s headquarters in Ohio.

In other studies we have used the term “image architects” to designate architects and engineers who are closely allied with retail chains and franchises.¹⁰⁷ These firms provide the consistent standard of design that is applied in stores throughout the country and the world. We believe that the cluster of firms in Ohio represent the image architects belonging to the Limited Group.

Additional nodes have been included in Figure 10 to illustrate the degree of interlinkage among retail firms as a result of their use of some of the same building professionals. Consider node 31, HBK, which is linked to the Limited Group, but also forms another cluster with nodes 9, 34, and 6. While HBK is not linked to node 22, Kravco Developers, Kravco is clearly linked with nodes 34 and 6. Remember that we treated all offices of the same company as part of the same entity, so that the HBK office(s) involved with node 34 may not be the same as the one that is involved with the “Limited.” Nonetheless, HBK is linked to both the Limited Group and the Gap Group (node 34). The important point is that firms of building professionals may influence multiple chains and retailers. Thus, these firms of building professionals are potentially important in efforts to market energy efficiency.

If one wants to work with the Limited Group on energy efficiency, it is important to target the key support firms in Ohio. This probably implies the need for a national rather than a local strategy for chains because the design standards set in Ohio are likely to be used throughout the country. The standards may be adjusted to meet the requirements of local codes or to respond to incentives at the local level. It also means that the target audience is a vice president at the “Limited” and professionals in these design firms, rather than each store that is being developed or the developer of the mall.

A public building cluster

The cluster with the largest number of nodes in the analysis was subsequently identified as a “public building” cluster. This cluster is shown in Figure 10. It contains 14 highly interconnected nodes. The nodes are identified in Table 11. Node 14 is at the center of this cluster. Node 14 is an architectural/engineering firm, Remington and Vernick. The single arrows emanating from node 14 are largely projects such as schools, colleges, public housing, hospitals, and other public facilities. Many of these also connect to the other nodes within the diagram but these linkages were suppressed in this diagram to make it more readable.

¹⁰⁷ Reed, J. H., et. al., “Market Segments in the Commercial Remodeling and Renovation Sector,” *Proceedings of the ACEEE Summer Study*, Washington, D. C. 2002. Reed, J. H., Andrew D. Oh, and Nicholas P. Hall, *The Structure and Operation of the Commercial Building Market, Proceedings of the ACEEE Summer Study*, Washington, D. C. 2000. Reed, J. H. and N. P. Hall, *PG&E Energy Center Market Effect Study*, San Francisco: PG&E, 1998.

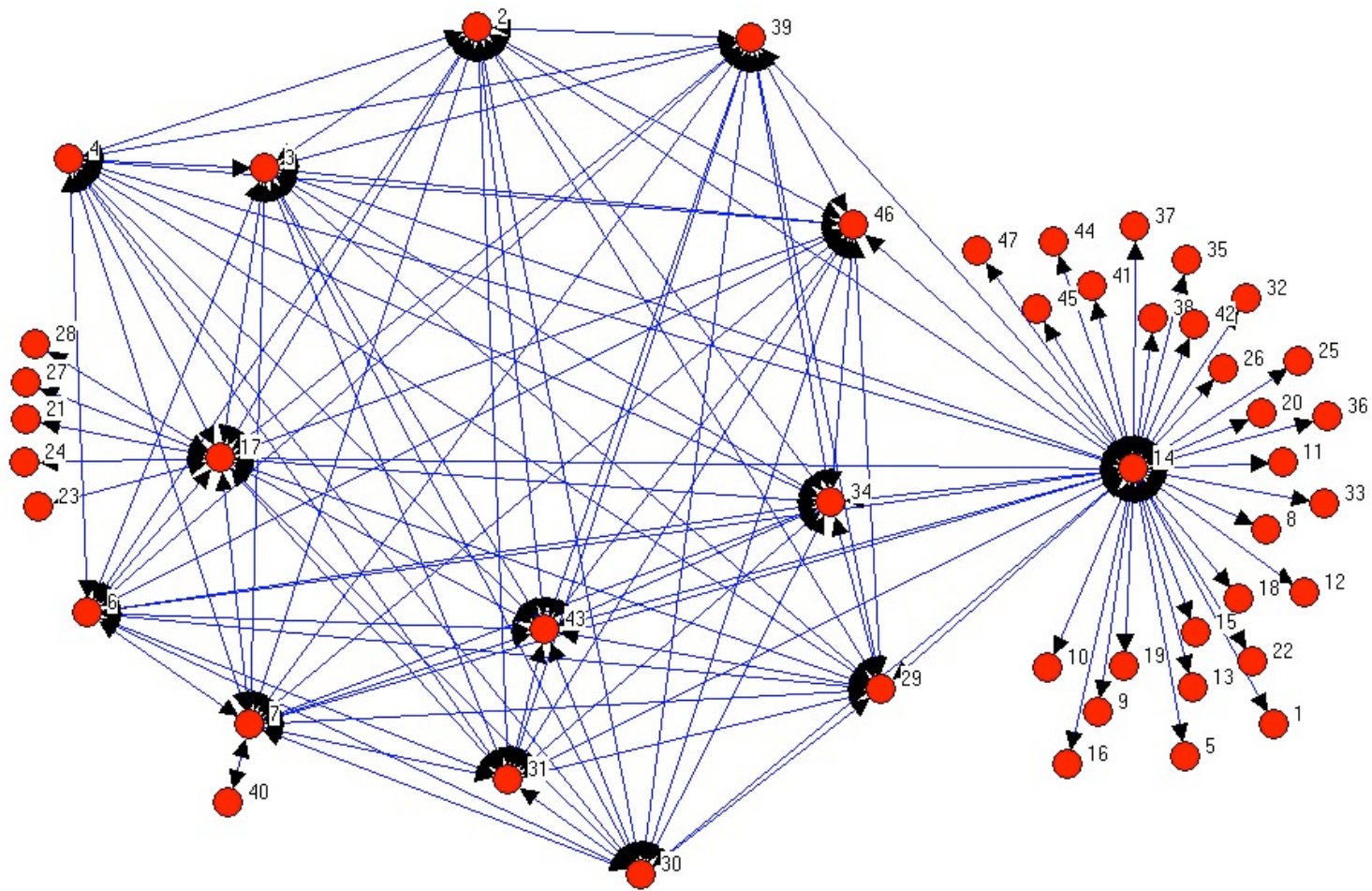


Figure 10 Network analysis of contractors working in public sector

With one exception, an architectural firm, all of the firms in the clique are construction, construction management, engineering firms, and owner agents. There is a high level of interaction among these firms in terms of the work they do in New Jersey. These players appear to have a local and regional base although they may have national or international bases as well. Clearly, this is a group of firms to target if the goal is to upgrade energy efficiency in the public sector.

Table 11 Identification of selected nodes in the “Public Building Cluster”

Node number	Company	Company type	Location
14	Remington and Vernick	Engineer	NJ
2	Gibbs and Cox	Engineer	NY
3	AMSEC M. Rosenblatt and Sons	Architect	NY
4	Han-Padron	Engineering	NY
6	Pennoni Associates	Engineer	NJ/PA
7	Anvil	Contractor	PA
17	Hill International	Construction Management	NJ
29	Envision	Contractor	NJ
30	Damiano Long	Engineer	NJ
31	AP Construction	Contractor	NJ
34	Hudson	Engineer	NJ
39	Creative Computer Solutions	Engineer / owner agent	NJ
42	Cooper Ferry	Owner agent	NJ
46	Weeks Marine	General contractor	NJ

Summary and Conclusions

In this chapter we have explored decision making in the commercial building market. In particular, we discussed five categories of decision makers: the capital providers, developers, users, building professionals, and community regulatory interests.

The **capital providers** make or influence decisions in important ways. They set the limits on a project. They place a value on the features and amenities in a building. And they commit to financing a building with those features. Once the financing is in place, the financing is unlikely to change. In certain circumstances, especially large projects, capital providers can be actively involved in high-level decision-making.

Secondly, changes in a construction project – and usually there are many – have to be accommodated within the financing package. In order to make changes one has to find savings. If there are unanticipated costs, then ways have to be found to accommodate them. Equipment and controls are frequently a target for cost savings. Thirty percent of new construction projects may be subject to value engineering.

A third and most important point is that financing is established, early, usually well before design drawings and detailed specifications are developed. In order to ensure that

energy efficiency is a part of the project, it must be considered in the cost estimates that are used to obtain the financing.

Developers are another important set of decision makers. Often they are multi-line businesses that bring together the investors, the designers, the contractors, and the users. Developers, as represented by the investment managers, are interested mostly in return on investment. Large developers/owners have staff to whom they delegate the details such as calculating return on investments for such things as energy efficiency projects. Managers pick and choose among the alternatives. In terms of promoting energy efficiency, detailed information about cost savings targeted to investment managers is likely to go unread. On the other hand, targeting managers with information that favorably compares a range of benefits from energy efficiency investments to other investments may get their attention. There is an information market place and the users of information are more likely to attend to information that meets their needs.

Secondly, developers have general investment strategies. These strategies set the parameters within which investments are made. The investment strategies encompass a much broader set of issues than energy efficiency. There are many opportunities to invest money in buildings. Among other things, one can upgrade a lobby, increase the speed of the elevators, buy improved maintenance equipment, upgrade space for a tenant, invest in energy efficiency, or buy another building. Each item represents an opportunity and has potential for return on investment.

Users are a third important category of decision makers. We speak of users rather than owners because users may be either lessees or owners. The owner-user who is paying the bill is likely to obtain the amenities that the owner desires. One of the important points in this chapter is that lessees can have significant influence over design decisions. This is particularly true of larger national retailers and large companies that lease significant amounts of office space. Decisions regarding how space can be used and modified in leased buildings are subject to negotiation between the lessee and the owner or the owner's representative. The degree to which a tenant can control the design and features of a space is largely a function of what the tenant is willing to invest in the space or to pay.

The lease is also important in terms of energy efficiency and energy costs. In many instances, leases are structured so that the costs and benefits of energy efficiency are not split. The notion that the commercial sector is difficult to deal with because of split incentives may only be true in a very small percentage of cases.

This chapter also discusses the role of **building professionals**. One of the key issues with respect to the role of building professionals is the degree to which they are able to integrate their efforts. Depending on the organizational model that is used to manage construction, building professionals may have more or less influence over decision-making. In the design/plan/build model, which is the traditional architect centric model, the architect plays a key role. In the design/build model, the contractor-developer is the key player. Other professionals tend to play much more supporting roles. In the emerging collaborative model, the team as a whole plays a much more central role in decision-making.

Community regulatory interests set codes and standards that represent a performance threshold that all builders and developers must meet. The standards are typically a compromise between high levels of energy performance and cost considerations. Codes lag technical performance potential but represent a way to incrementally improve the performance of the building stock.

The **role of networks** was also briefly discussed in this chapter. Although the idea of networks is not new, it is new to the field of energy efficiency. The identification and use of networks potentially represents a powerful way of diffusing technology within the commercial building market.

As this chapter illustrates, decisions about commercial buildings are highly complex and involve gathering information from and for a variety of different market actors. Many times, a few market actors may be responsible for making decisions about many buildings. Moreover, these same decision makers may have interlocking roles in both new and existing office buildings. Finding these commonalities has been quite difficult in the past. Network analysis, which traces the inter-relationships among various market players, makes it easier to find these common links.

Chapter 4 A Statistical Profile of the Commercial Building Market

Introduction

The commercial new construction market is a vital subset of the larger commercial building market. In order to establish a context for understanding the commercial new construction market, it is important to know about the size, type, and distribution of existing commercial buildings. The purpose of this chapter is to provide a broad-brush view of existing commercial buildings. Various sub-markets are examined with respect to their size and the energy intensity of buildings.

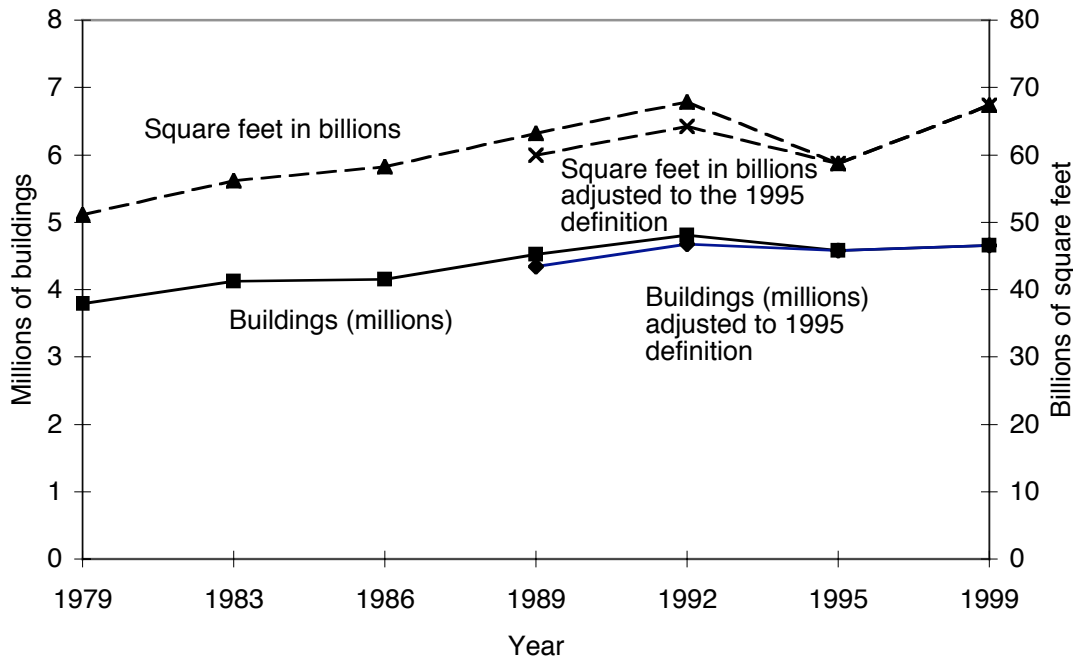
Definition of commercial space

In the simplest terms, commercial buildings are those buildings that are not used for industrial, residential, or agricultural purposes. The Nonresidential Buildings Energy Consumption Survey (CBECS) defines commercial spaces as those structures or parts of structures that are used for offices, food sales, retail/service, lodging, healthcare, religious worship, education, public assembly, food service, public order and safety, and warehouses and storage. Prior to 1995, CBECS defined “nontraditional” uses, such as parking garages and office space in manufacturing buildings, as commercial space. This was discontinued with the 1995 survey.

There are other definitions of commercial buildings. For example, utilities often include larger multifamily buildings in the definition of commercial buildings. In this report, we will use the CBECS definition.

Size and scope of the commercial market in the United States

The number of commercial buildings in the United States has increased steadily for the past two decades (Figure 11). In 1979, CBECS estimated that there were 3.8 million commercial buildings in the United States. By 1992, that number had increased 27 percent to 4.8 million, an average annual increase of 1.8 percent. During this same 20-year span, the amount of floor space went from approximately 51 billion to 67 billion square feet. The slight decline in 1995 is attributable to a change in the definition that took affect that year and the resulting variation in the estimates. The difference between 1992 and 1995 is not statistically significant. There was a decline in new construction in the early 1990s, and it is possible that there was a slight decline in the number of buildings in 1995 but it is not likely. The important point is that on average, the number of new buildings probably increased between 1.5 and 2.0 percent annually, although there are periods in which the increase is more rapid than in others.



Source: EIA, CBECS Survey, 1999

Figure 11 Estimates of millions of commercial buildings and billions of square feet of floor space, 1979 to 1999¹⁰⁸

Buildings and square footage

When we think of commercial buildings, we tend to think of large buildings such as high-rise buildings in center cities or big box stores. However, most commercial buildings in the United States (74 percent) are less than 10,000 square feet (Table 12). That is the area of a very modest residential lot in a suburb. Fully one-half of all commercial buildings (50 percent) are between 1,000 and 5,000 square feet, while another 24 percent are between 5,001 and 10,000 square feet. The size of buildings is important because the technologies that are used in buildings change with size. In terms of the number of pieces of equipment, the market for small commercial buildings is much larger than that for large commercial buildings. The issue of the types of equipment is revisited in later sections.

¹⁰⁸ The discontinuity in the graph is likely a result of the change in the way that the target population of commercial buildings was defined in 1995 and the uncertainty of estimates from sample surveys. Two types of buildings, parking garages and commercial buildings on multi-building manufacturing facilities, that had been included in previous surveys were excluded beginning with the 1995 CBECS. When the 1992 estimate of total buildings is adjusted to match the 1995 definition, the 1992 estimate is reduced 3.8 percent to 4.7 million buildings. CBECS is a sample survey; each estimate has a range of uncertainty because of sampling error. When the 95 percent confidence ranges for the estimates are applied, the differences among the 1992, 1995, and 1999 estimates are not statistically significant.

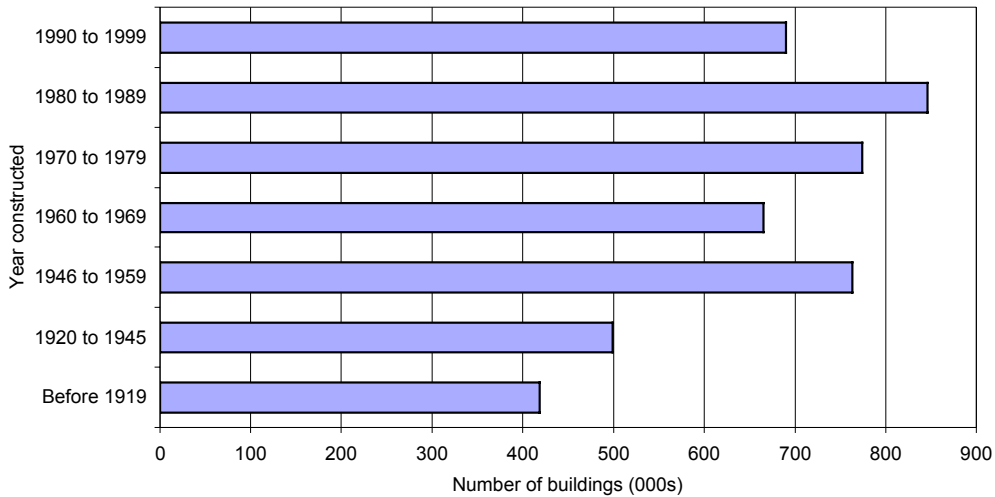
Age of buildings

According to EIA, there has been a 66 percent increase in the number of buildings during the last century. Slightly more than half of commercial buildings were constructed before 1970. The remainder has been constructed since 1970. Fifteen percent were constructed in the 1990s and 18 percent in the 1980s, making the 1980s the period of most intense commercial building construction. The next most rapid period of increase was between 1970 and 1979 followed by 1990 and 1999. Prior to 1960, the age intervals in the chart are of different durations, which perceptually tends to make the number appear larger than it is.

Table 12 Distribution of building floor space in the U.S. (1997)

Square footage in the building	Number of buildings (000s)	Percent of buildings
1,001 to 5,000	2,348	50.4
5,001 to 10,000	1,110	23.8
10,001 to 25,000	708	15.2
25,001 to 50,000	257	5.5
50,001 to 100,000	145	3.1
100,001 to 200,000	59	1.3
200,001 to 500,000	23	0.5
Over 500,000	7	0.2
Total	4,657	

Source: EIA, CBECS, 1999, Table B12



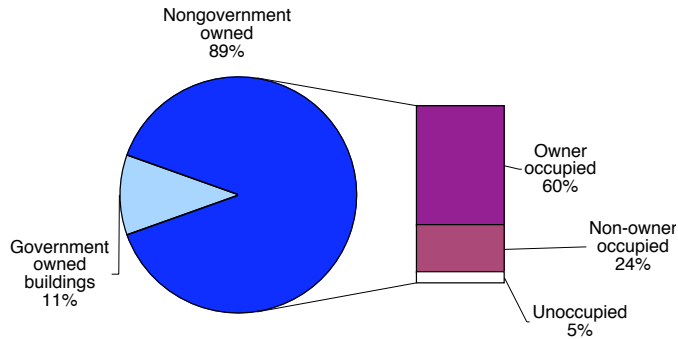
Source: EIA, CBECS, 1999

Figure 12 Number of buildings constructed by year

Ownership of commercial buildings

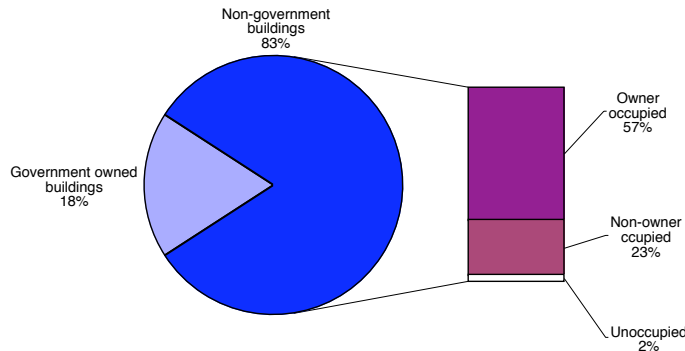
Most of the 4.7 million commercial buildings in the United States are privately owned (89 percent) and sixty percent of those are owner-occupied (Figure 13). The picture shifts slightly when the square footage rather than the number of buildings is considered. Eighty-three percent of total commercial building square footage (67 billion square feet) is non-government owned buildings and eighteen percent is government owned. The percentage of owner occupied floor space is about 57 percent of all floor space and 69 percent of non-governmental floor space (Figure 14).

If for non-government owned structures, retail other than mall (4.8 billion square feet), retail and strip malls (5.6 billion square feet), and services (2.5 billion square feet) are combined, then the total retail and services floor space is about 12.9 billion square feet (Figure 15). Office space is the next largest block of commercial space (10.4 billion square feet). This is followed by warehouse and storage with slightly under 10 billion square feet. Most other commercial sub-markets occupy less than four billion square feet. The education sub-market accounts for the largest amount of governmental floor space. Office, public assembly, and the public safety sub-markets account for much of the remaining government floor space.



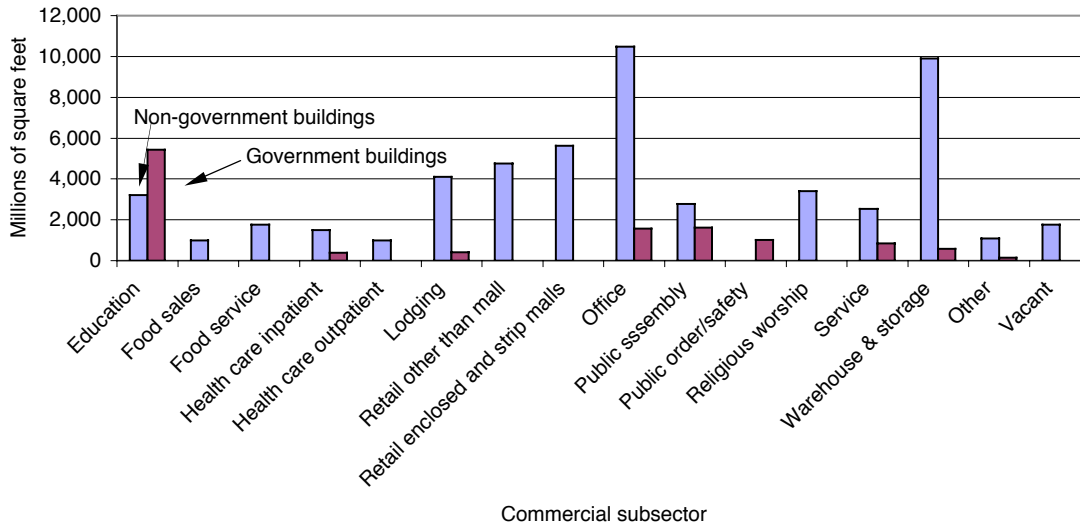
Source, EIA CBECS, 1999, Table B12

Figure 13 Ownership of commercial buildings in numbers



Source, EIA CBECS, 1999, Table B13

Figure 14 Nongovernment ownership of commercial buildings as percent of square feet



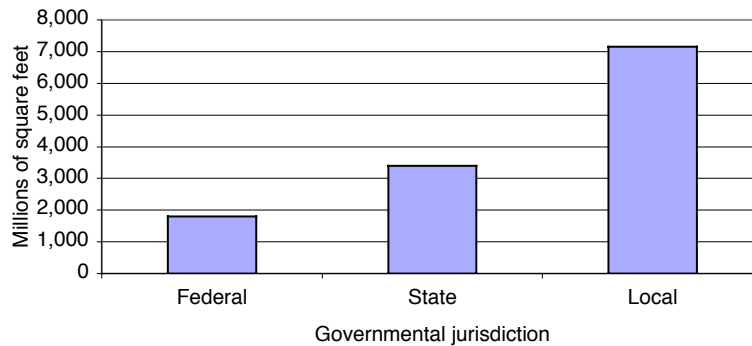
Source: EIA, CBECS, 1999, Table B13

Figure 15 Ownership and square footage of buildings in the commercial sector

Local governments hold the largest amount of governmental space and the Federal government the least (Figure 16). This is not surprising given the number of local governmental entities and the importance of education at the local level.

From a policy stand point, retail, commercial office, and warehouse storage buildings account for the most floor space in the nongovernmental sector. Education buildings and buildings belonging to local governments are most numerous in the governmental sectors.

Within the public policy literature, there is much discussion about the importance of split incentives as a barrier to market transformation, especially in the commercial sector. Split incentives occur when a party other than the party making



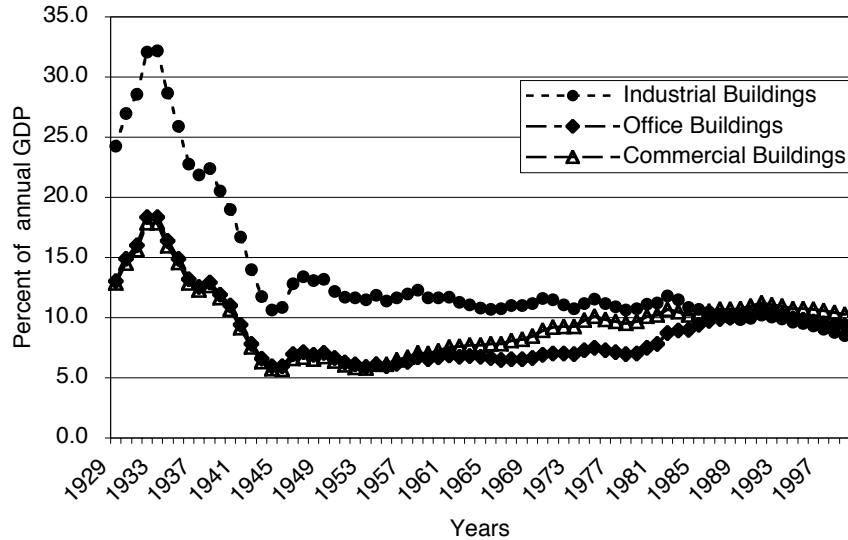
Source EIA, CBECS, 1999 Table B13

Figure 16 Government ownership of commercial buildings in millions of square feet

a capital investment (the owner) receives the benefits from the investment (tenants have reduced energy costs from installing energy efficient equipment). The fact that 70 percent of nongovernmental buildings are owner occupied suggests that split incentives may potentially only be an issue in 30 percent of commercial building space. Later, we will argue that split incentives may be an issue in much less space than that.

The value of commercial buildings and construction through time

As a percentage of gross domestic product, the value of industrial, commercial, and office buildings peaked just before the Great Depression in 1932 and then began to decline. In the post-WWII era, the value of office buildings (Figure 17), as a percentage of annual Gross Domestic Product (GDP), remained at about six percent until about 1980 when the value began increasing and reached 10 percent around 1993. For the 13 years following



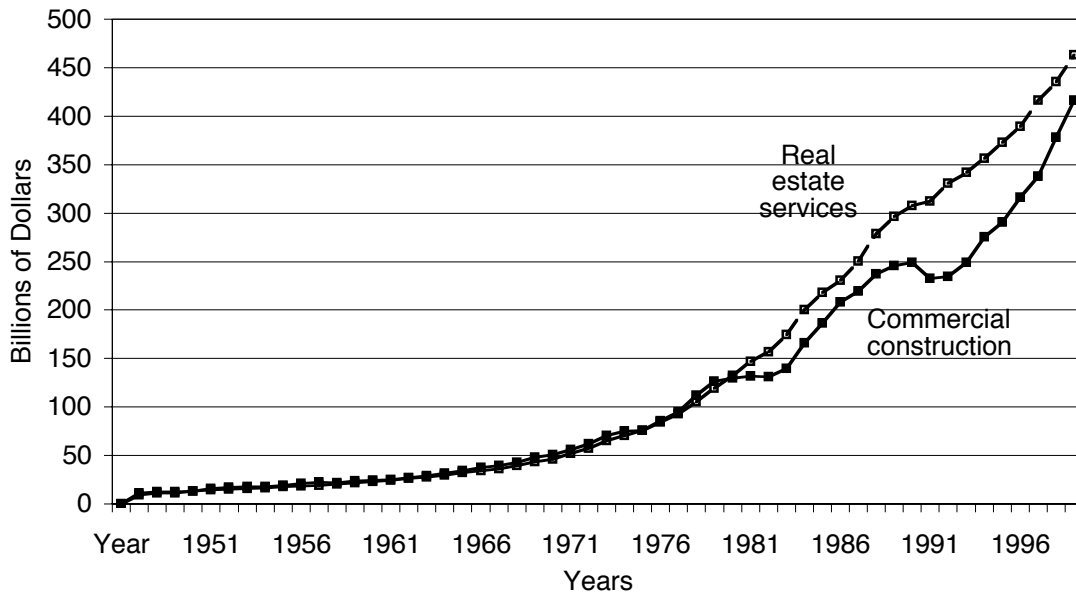
Source Bureau of Economic Analysis and Urban Land Institute, Table 4:1 Value Relative to annual GDP 1929-1999, chained in 1996 dollars.

Figure 17 Value of industrial, commercial, and office buildings

World War II, the value of commercial buildings was also around six percent. It then increased until the 1980s where it leveled off at about 10 to 11 percent. The value of industrial buildings was fairly constant as a percentage of GDP from 1953, about 12 percent, until the end of the 1980s when it declined to less than 10 percent. What these data appear to show is that the value of commercial buildings as a percentage of GDP increased in the 1960s, the values of offices increased in the 1980s, and the value of industrial buildings declined slightly until the 1990s when the decline became a bit more rapid. What these trends represent is a shift from an industrial to a commercial retail and services base. The shift to commercial retail occurred first followed by the shift to services. All three indices seemed to be declining in the late 1990s. The question is, what comes next?

Figure 18 shows the value of commercial construction and real estate services from 1947 to 1999 in chained 1996 dollars. There was steady growth in commercial construction through 1978, a leveling off, and then a resumption of growth in 1983. There was a decline in construction activity in 1990 with construction activity recovering to 1990 levels in 1993. The hyperactivity of the 1980s appears to have repeated itself in the 1990s.

Real estate services are services such as selling, appraising, renting, managing, and/or buying real estate for others. It is interesting to note that real estate services have exhibited a constant upward trend with no absolute declines in value.



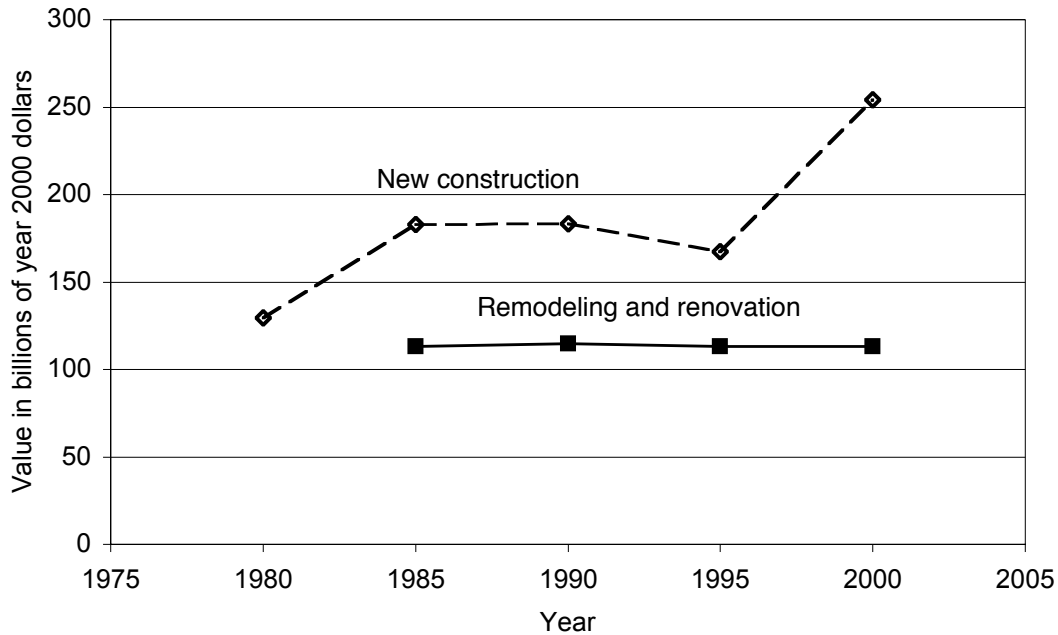
Source: Bureau of Economic Analysis, Table 6.1: Output of Real Estate Services and Commercial Construction 1947-1999

Figure 18 Growth of real estate services and commercial construction 1947-1999

Construction and remodeling in the commercial building sector

In 2000, the value of construction in the commercial building sector was \$367 billion or about four percent of the gross domestic product (Figure 19). The value of new construction is slightly more than two-thirds of that or \$254 billion. About \$115 billion is for building renovation, modifications, and repair.

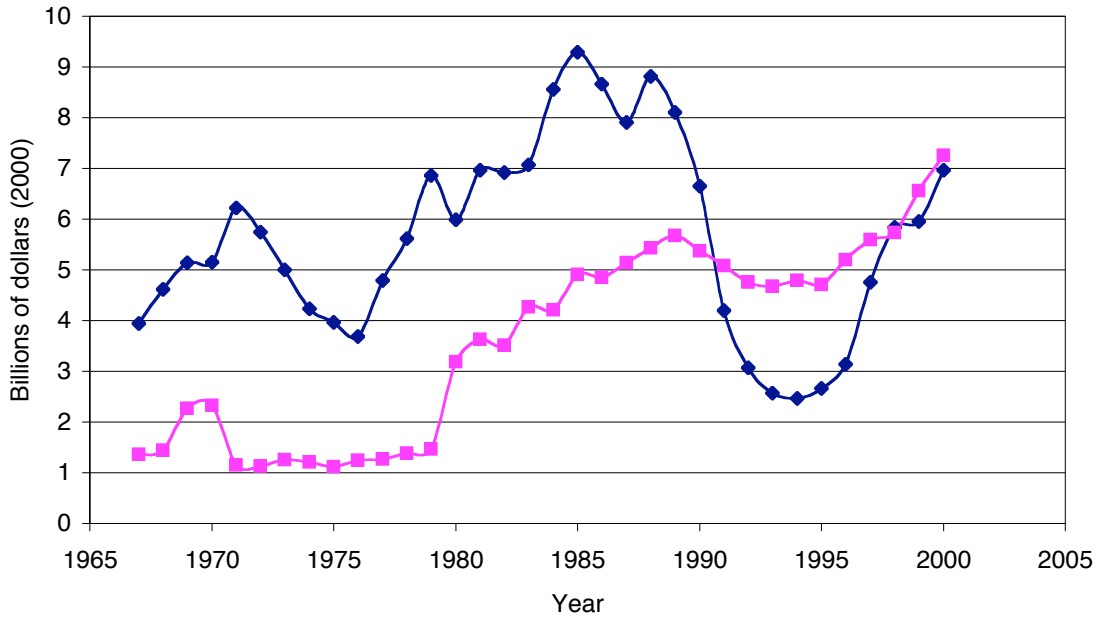
Figure 19 illustrates the estimated value of the total new construction and remodeling and renovation projects in the commercial building market since 1980. The estimates point to an increase in new construction between 1980 and 1985 with a sustained level of construction from 1985 to 1990. There was a dip in new construction between 1990 and 1995 and then a sharp increase between 1995 and 2000. The value of remodeling and renovation is fairly constant at around 115 billion in constant dollars. What is noticeable here is the consistency of the value of the remodeling and renovation market against the somewhat more volatile new construction market.



Source: 2002 Buildings Energy Databook, Tables 5.1.2 and 5.3.1

Figure 19 Value of new construction, remodeling and repair in the commercial building market

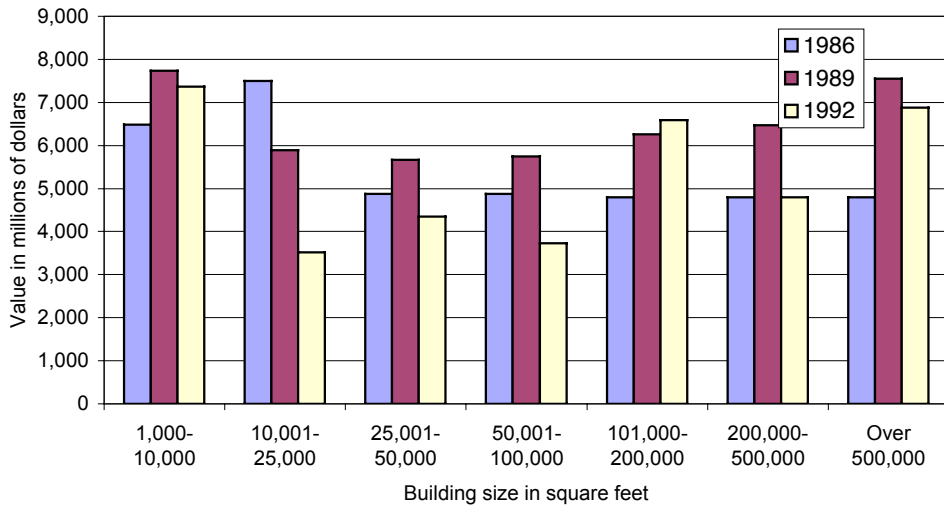
There is an equally if not more interesting pattern that is observable in the time series data for California (Figure 20). For the period between 1965 and 2000, new construction activity peaked in the early 1970s, tailed off through the mid-1970s, surged again through the 1980s, and then declined before increasing again at the end of the 1990s. While California renovations, alterations, and additions follow the general upward trend of new construction, renovations, alterations, and additions remained somewhat constant during the new construction downturn in the 1970s and did not decline as much during the new construction downturn in the 1990s. Thus, the remodeling of existing buildings appears to be somewhat less volatile than new construction and appears to be less responsive to changes in the economy. While changes in the economy may cause some postponement of modifications to existing buildings, changes to the economy seem to have a much more drastic effect on new construction.



Source: Dorhman, et. al.

Figure 20 New construction and renovations, alterations, and additions in California from 1965 to 2000

Figure 21 shows how the value of nonresidential construction varies by the size of buildings. For the short historical period for which there is data, the largest amount of construction occurs for buildings of less than ten thousand square feet, for buildings in the 100 to 200 thousand square feet range, and for buildings more than 500,000 square feet. Buildings of around 100,000 square feet are slightly larger than the average size of a big

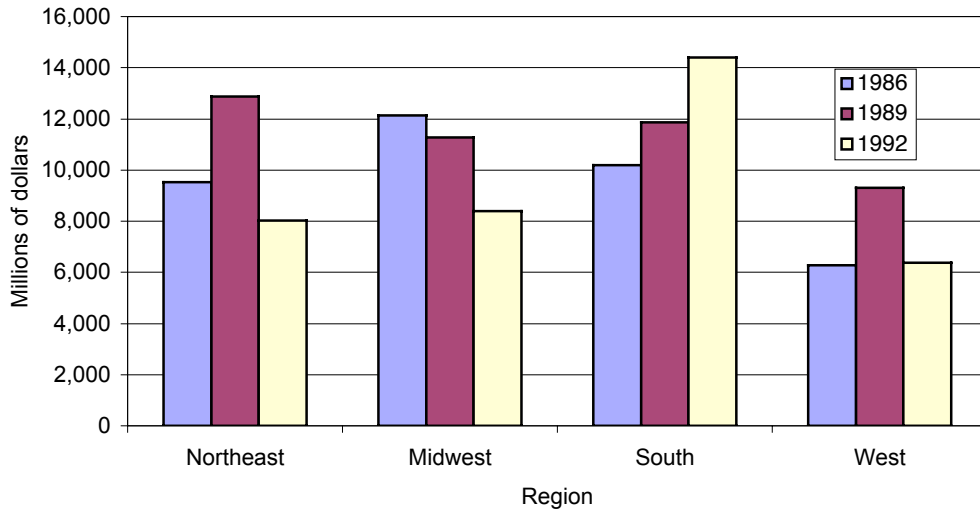


Source: EIA, CBECS 1999

Figure 21 Expenditures for private nonresidential buildings in millions of dollars by building size for selected years

box store.

There are regional differences in new construction. The value of new construction for selected years was lowest overall in the West and highest on average in the South. Figure 22 shows that the value of new construction declined during the selected years in the Midwest but increased in the South.

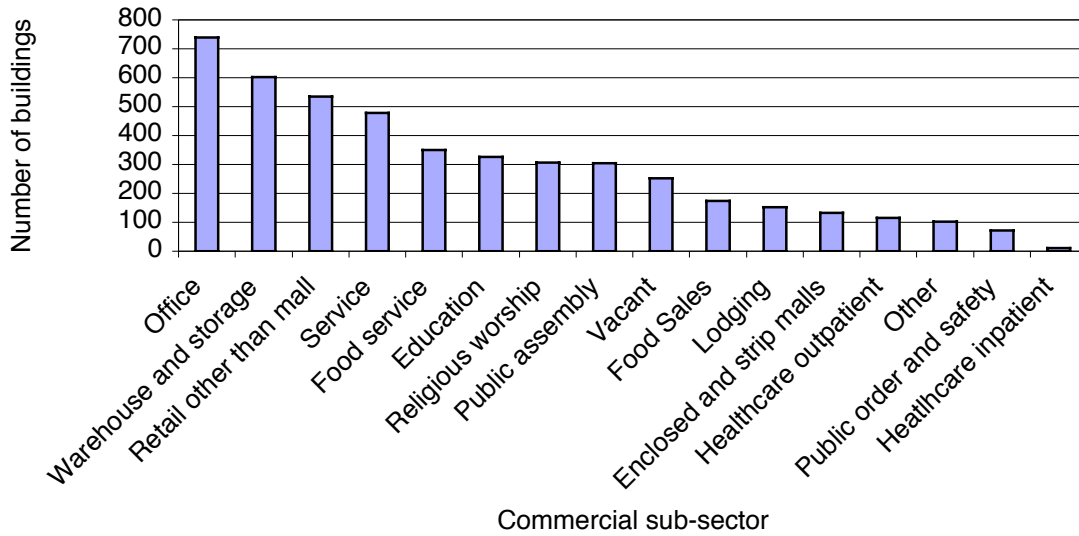


Source: DOE, EIA, CBECS

Figure 22 Value of improvements by census region

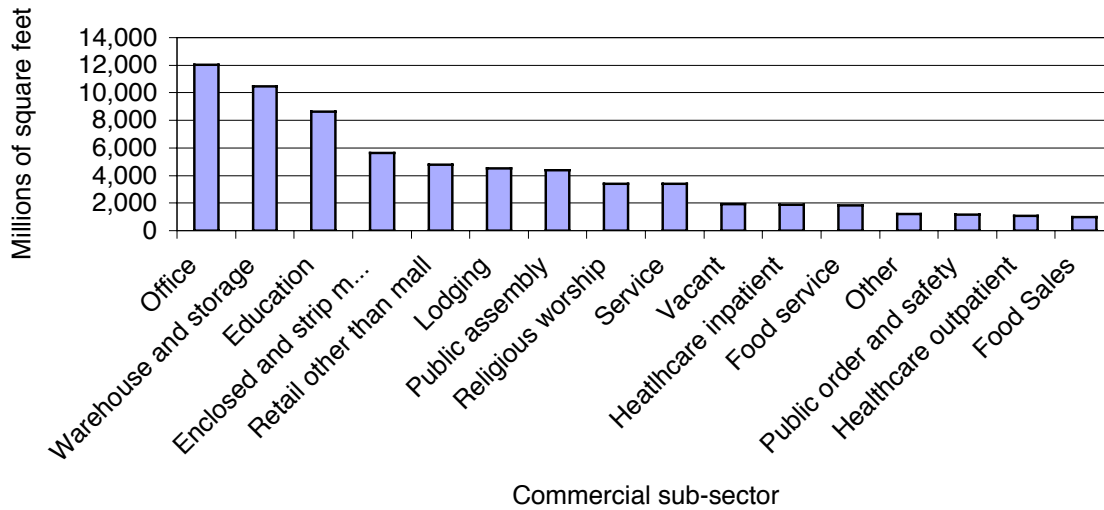
Types of buildings in the commercial sector

Retail and service buildings dominate the commercial sector. If retail other than malls, enclosed and strip malls, and service buildings are combined into a retail sector, they represent approximately 30 percent or 1.3 million of the total estimated 4.6 million commercial buildings (Figure 23 and Figure 24). This combined group of buildings represents 12.9 billion of the total 67 billion square feet or about 20 percent of the total of commercial floor space. Within this combined retail sector, enclosed and strip malls occupy the largest proportion of space, 41 percent, other retail 35 percent, with the balance of the space occupied by services. Office buildings are the next largest number of buildings (739,000) with slightly more than half of the number of retail and service buildings. However, they occupy about 90 percent of the amount of space of retail and service buildings. Warehousing, food service, and education follow in terms of the number of buildings. Warehousing, lodging and public assembly follow in terms of square footage.



Source: EIA CBECS 1999, Table C3

Figure 23 Number of commercial buildings by type of activity (in thousands)



Source: EIA CBECS, 1999 Table C3

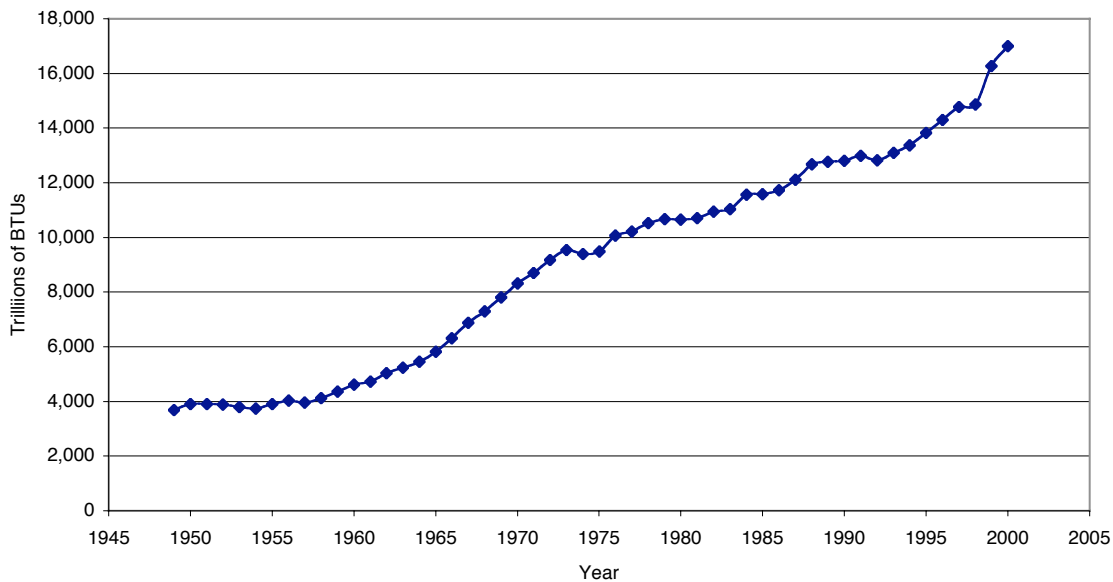
Figure 24 Total floor space of commercial buildings by activity type

For the most part, the ranking of the sectors in terms of the number of buildings and the amount of square footage parallel one another although there are some differences. The number of food services establishments is fifth in terms of the number of buildings but 12th in terms of square footage. The food sales sector ranks 10th in number of buildings but 16th in terms of total square footage. These differences probably reflect the relative numbers of stand alone fast-food restaurants and small grocery stores with relatively small footprints.

Healthcare establishments are also notable because the number of outpatient establishments is much higher than the number of inpatient facilities. Healthcare inpatient establishments are relatively few in number but have fairly large footprints compared to the outpatient establishments. As we shall see later, one of the trends in healthcare is the move to delivery of services in suburban office buildings that is being made possible by changes in treatment and testing technologies and medical techniques that are less invasive.

Energy use in commercial buildings

Energy use in commercial buildings has not quite quadrupled in the last half-century (Figure 25). Consumption increased dramatically since 1949 peaking in 1973 around the



Source: EIA Historical Energy Consumption Tables, 1949-2000

Figure 25 Historical energy consumption in the commercial building market 1949-2000

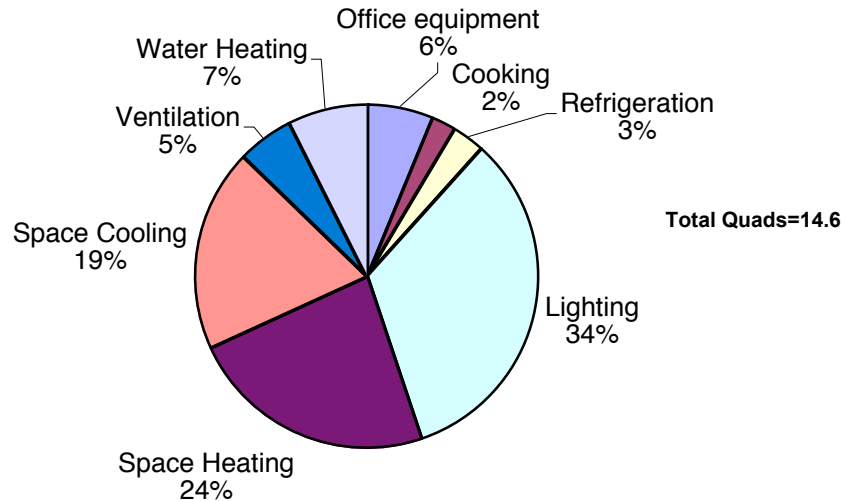
time of the first oil price shock. Consumption in the commercial sector briefly fell and then rose again until 1978-1979 at the time of the second oil price shock. Through the early 1980s, consumption in the commercial sector increased more slowly than in the 1960s and 1970s. There was a slight decrease in the early 1990s and then a take off as building consumption increased in the late 1990s.

EIA predicts that this upward trend will continue between now and 2010 as the commercial building market increases by 19 billion square feet. Due to this projected growth in the number of buildings and energy intensity within them, energy consumption and associated economic and environmental costs will likely continue to increase.¹⁰⁹

¹⁰⁹ The end-use splits represented in this chart differ from that reported in the EIA Annual Energy Outlook, 1997. This chart includes data for industrial buildings that are not reported by EIA. In addition, energy for "District Services" (heating and cooling) and "Other Fuels" (heating), lumped by EIA under

Of the estimated 90 quadrillion Btu's (quads) of primary energy used in the United States in 1995, the 4.7 million commercial buildings accounted for approximately 14.3 quads or 16 percent of the total energy.¹¹⁰

Space conditioning (heating, cooling, ventilation) represents the largest energy use in buildings, fully 45 percent of the total (Figure 26). Space heating accounts for slightly more than a fifth of the usage, space cooling slightly less than a fifth, and ventilation about five percent. Lighting is nearly a third of that energy use. Office equipment ac-



Source: EIA Situation Analysis, 1997

Figure 26 1995 commercial building end-use splits

counts for about six percent. Water heating, cooking, and refrigeration are fairly small uses. More than \$220 billion is spent each year in the U.S. to provide heating, cooling, lighting, and related services for its buildings.

The bottom line is that space conditioning and lighting are the main loads in commercial buildings. There has been some recent discussion about the growth in office equipment and increased energy use. The best data seem to suggest that the proportion of energy being used for office equipment is relatively stable.

End-use intensity by sub-market

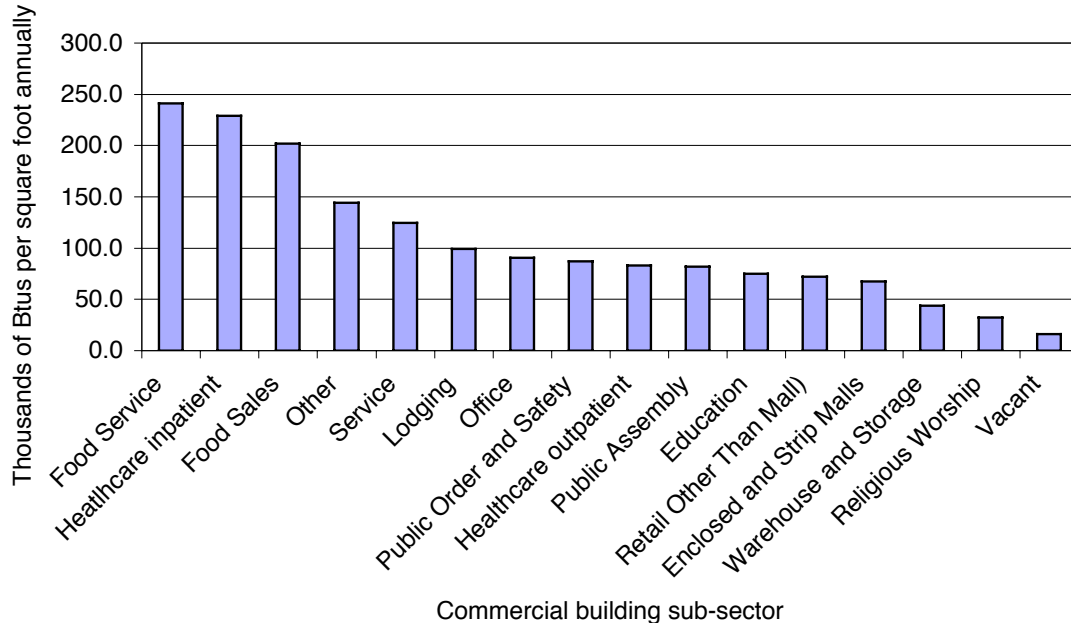
Figure 27 shows the energy use intensities for buildings in each of the commercial sub-markets in terms of thousands of Btus per square foot annually. The sectors with the

"other," is attributed to space conditioning. Finally, the statistical adjustment of 1.6 quads required for the Annual Energy Outlook to be consistent with the State Energy Data System has been deleted from "Other".

¹¹⁰ According to the Energy Information Administration, Annual Energy Outlook (1997), the residential (18.43) and commercial (14.33) sectors totaled 32.76 quads in 1995 out of a total 90.93 quads of primary energy use.

highest intensities are food service, inpatient healthcare, and food sales. Buildings in these sectors have energy intensities of more than 200,000 Btus per square foot annually.

Lodging, offices, education, and retail have annual energy use intensities of about half of this value or less.



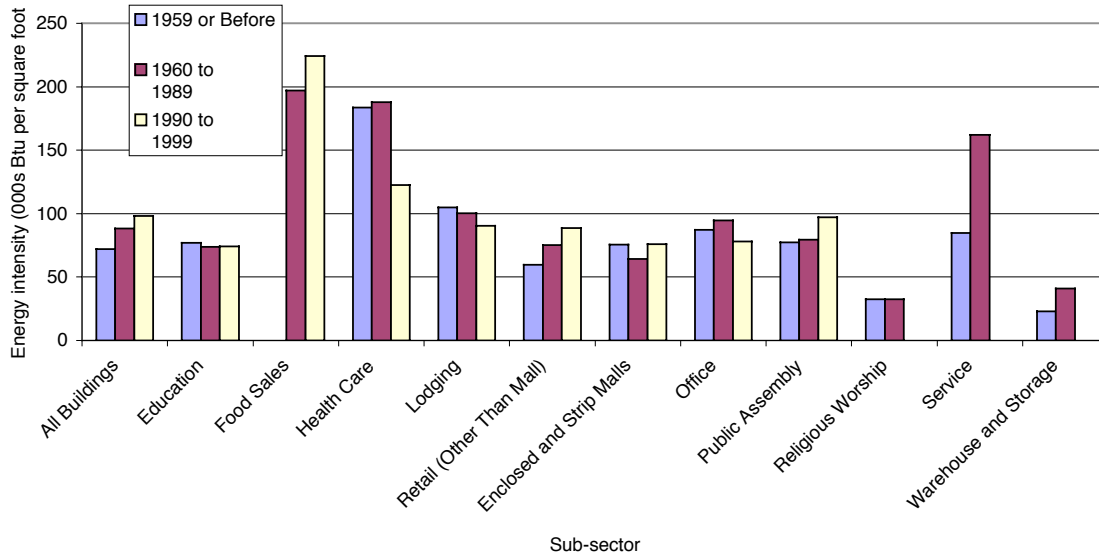
Source: CBECS, 1999, Table C-3.

Figure 27 Energy intensity of buildings in commercial building sub-markets

Historical change in energy intensity

From Figure 28 we can glean some idea of how energy intensities in commercial building have changed in the last 50 years. These data show the energy intensity of buildings by their age. For all buildings in the commercial sector, the energy intensities of newer buildings have increased. For the healthcare, office and lodging sub-markets, energy intensities appear to have declined during the 1990s. However, for the healthcare sector we should exercise some caution in interpreting this finding because healthcare, as represented in this graph, includes both the inpatient and outpatient sub-sectors. We know there has been an increase in outpatient care, especially in more recent years, and energy intensities in the outpatient sector are somewhat lower than in the inpatient sector. Thus, some of the decline in this sub-sector may be attributable to changes in how care is provided rather than in the intensity of the usage.

Energy intensity appears to have increased in retail other than malls, food sales and public assembly. In the education sub-market and the mall portion of the retail market, energy intensity appears to have remained relatively flat. Data for some of the other sub-markets is incomplete so that it is difficult to make judgments about trends.



Source: CBECS, 1999, Table C-8.

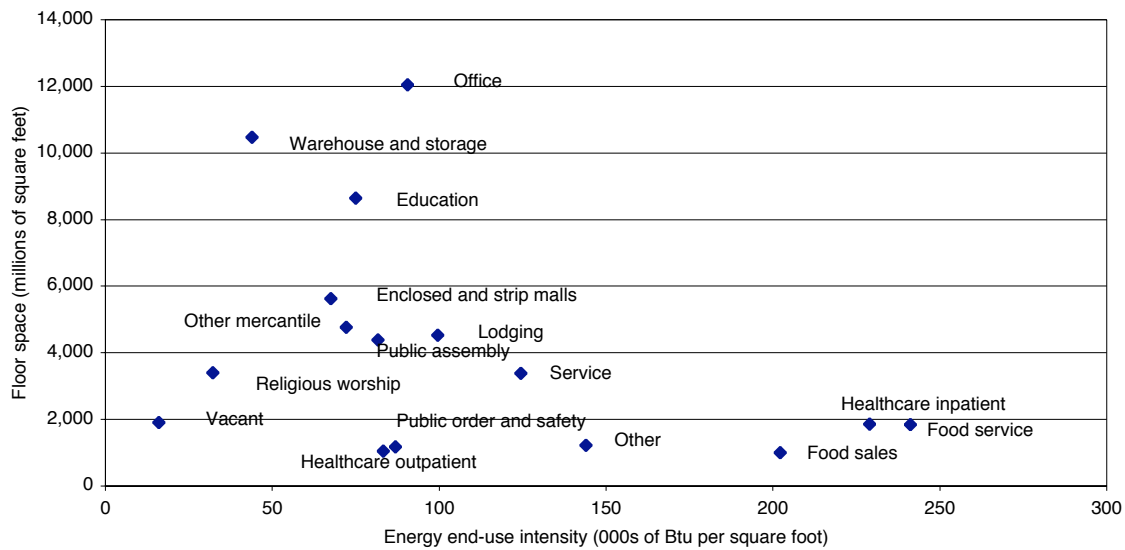
Figure 28 Energy intensity by sub-market in three time periods

Energy intensity and floor space in the commercial sub-markets

From the standpoint of prioritizing energy efficiency efforts within the sub-markets, buildings can be examined in terms of energy intensity and square footage of floor space. Sub-markets with low energy intensities and lesser amounts of floor space may be of less interest in policy terms than sub-markets with high energy intensities and/or large amounts of floor space.

Healthcare, food services and food sales have high intensities but relatively small amounts of floor space. The office and education sub-markets have moderate energy intensities but large numbers of buildings. Enclosed and strip malls, other mercantile, public assembly, lodging, and services are characterized by moderate energy intensities and modest amounts of floor space. The healthcare outpatient sector is characterized by moderate energy intensities but small amounts of floor space. This is mostly office space where patients visit doctors and receive additional services. The energy intensity of this space corresponds to that of office space. This will be discussed in greater detail in the chapter on the health sub-market.

Warehouse and storage, religious worship, and vacant spaces have low energy intensities. However, the square-footage of space devoted to warehouses is among the largest amounts. As we shall see later, warehouse and storage buildings may be divided into warehouses with and without refrigeration. The energy intensity of refrigerated warehouses is somewhat higher than for warehouses in general. Furthermore, the warehousing industry is changing in ways that may change the patterns of energy use.



Source: EIA, CBECS 1999, Table C-3

Figure 29 Sub-markets by floor space and energy intensity

Summary and conclusions

In 1999, there were 4.7 million commercial buildings encapsulating 67 billion square feet in the United States. Most commercial buildings in the United States (74 percent) have less than 10,000 square feet.

The size of buildings is important because of ownership patterns and the technologies that are used in buildings change with size. In terms of the number of pieces of equipment, the market for small commercial buildings is much larger than that for large commercial buildings.

There has been a 66 percent increase in the number of buildings during the last century. Slightly more than half of commercial buildings were constructed before 1970. Fifteen percent were constructed in the 1990s and 18 percent in the 1980s making the 1980s the period of most intense commercial building construction.

Eighty-three percent of total commercial building square footage (67 billion square feet) is non-government owned buildings and one-sixth is government owned. The percentage of owner-occupied floor space is about 57 percent of all floor space and 69 percent of non-governmental floor space.

Retail and services occupy the largest amount of floor space, about 12.9 billion square feet. Office space is the next largest block of commercial space (10.4 billion square feet). This is trailed by warehouse and storage with slightly under 10 billion square feet. Most other commercial sub-markets occupy less than four billion square feet.

In recent years there has been much discussion about the importance of split incentives as a barrier to market transformation, especially in the commercial sector. Split incentives occur when a party other than the party making a capital investment (the owner) receives

the benefits from the investment (tenants have reduced energy costs from installing energy efficient equipment). The fact that 70 percent of non-governmental buildings are owner occupied suggests that split incentives may only be an issue in 30 percent of commercial building space.

The value of commercial buildings as a percentage of GDP increased in the 1960s, the value of office buildings increased in the 1980s, and the value of industrial buildings declined slightly until the 1990s when the decline became a bit more rapid. What these trends represent is a shift from an industrial to a commercial retail and services base. The commercial retail came first followed by the services. All three indices declined in the late 1990s raising the question of what is to follow.

In 2000, the total of construction for all commercial buildings was about \$365 billion. One hundred fifteen billion of that was remodeling and renovation and the rest was new construction. Overtime, new construction tends to be about two-thirds of the commercial building construction total and renovation and remodeling about one-third. Over time, remodeling of existing buildings appears to be somewhat less volatile than new construction and appears to be less responsive to changes in the economy. While changes in the economy may cause some postponement of modifications to existing buildings, changes to the economy seem to have a much more drastic effect on new construction.

Retail and service buildings dominate the commercial sector. They represent 13.7 billion of the total 67 billion square feet or about 20 percent of the total of commercial floor space. Office buildings are the next largest number of buildings (739,000) with slightly more than half of the number of retail and service buildings. However, they occupy about 90 percent of the amount of space of retail and service buildings. Warehousing, food service, and education follow in terms of the number buildings. Warehousing, lodging, and public assembly follow in terms of square footage.

Of the estimated 90 quadrillion Btus (quads) of primary energy used in the United States in 1995, the 4.7 million commercial buildings accounted for approximately 14.3 quads or 16 percent of the total energy.

Space conditioning (heating, cooling, and ventilation) represents the largest energy use in buildings, fully 45 percent of the total. Space heating accounts for slightly more than a fifth of the usage, space cooling slightly less than a fifth, and ventilation about five percent. Lighting is nearly a third of that energy use. Office equipment accounts for about six percent. The bottom line is that space conditioning and lighting are the main loads in commercial buildings.

Buildings in the food service, inpatient healthcare, and food sales sub-markets have the highest energy intensities using more than 200,000 Btus per square foot annually. Lodging, offices, education, and retail have annual energy use intensities of about half of this value or less.

If sub-markets are examined by energy intensity and floor space, healthcare and food services and sales have high intensities but relatively small amounts of floor space. The office and education sub-markets have moderate energy intensities but large numbers of buildings. Enclosed and strip malls, other mercantile, public assembly, lodging, and

services are characterized by moderate energy intensities and modest amounts of floor space.

There are a half dozen key points from this chapter:

- A high percentage of commercial buildings are owner occupied. Split incentives are not a barrier to the adoption of energy efficiency for this group.
- Half of commercial buildings are less than 5,000 square feet. Efficiency efforts need to be geared to these properties as well as larger properties.
- The efficiency programs that have been largely operated by utilities and regional transformation organizations have been oriented to lighting and cooling. Heating is a large load that needs attention as well.
- Construction in the commercial building sector was strong in the 1980s and 1990s. Building construction in the office, retail, and industrial markets was declining as a percentage of GDP in the late 1990s suggesting some uncertainty about the future.
- In the overall commercial building market, remodeling and renovation tends to be fairly constant in the commercial building market, but new construction is more volatile trending with economic ups and downs.
- Historically, small and large buildings rather than mid-sized buildings have been most commonly constructed.
- Overall energy use and overall energy intensities have risen over the years. Energy intensity appears to have declined in the healthcare, office, and lodging sub-markets during the 1990s. However, the decline in the healthcare sub-market may have resulted from a structural shift in how services in the sub-market are delivered.
- Taking into account energy intensity and/or the amount of space, healthcare, food sales and service, office space, retail and service, lodging, education and wholesaling are all areas of potential interest with respect to energy efficiency.

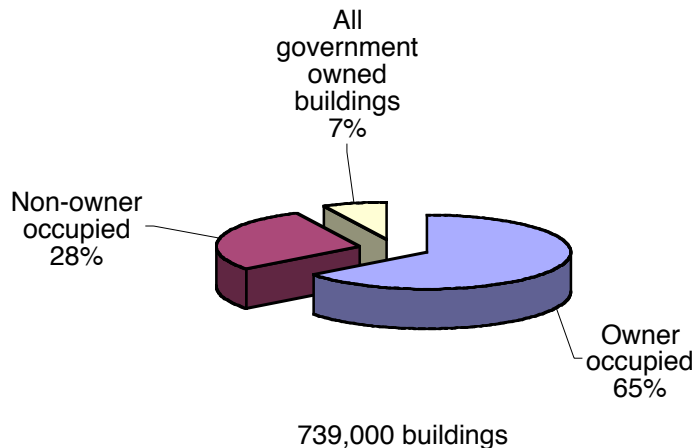
Chapter 5 The Office Sub-Market

An overview of the office sub-market

The office sub-market is the second largest sub-market in the commercial building market. The office market is divisible into the public sector, private sector owner occupied, and the private sector non-owner occupied. The private non-owner occupied sector is what we usually think of as the commercial office lease market. The commercial office lease market is made up of properties that are owned and managed for lease to others.

There are 739,000 office properties in the United States (Figure 30). Most (65 percent) are owner occupied. More than one-quarter of the buildings are non-owner occupied and the remainder are government occupied.

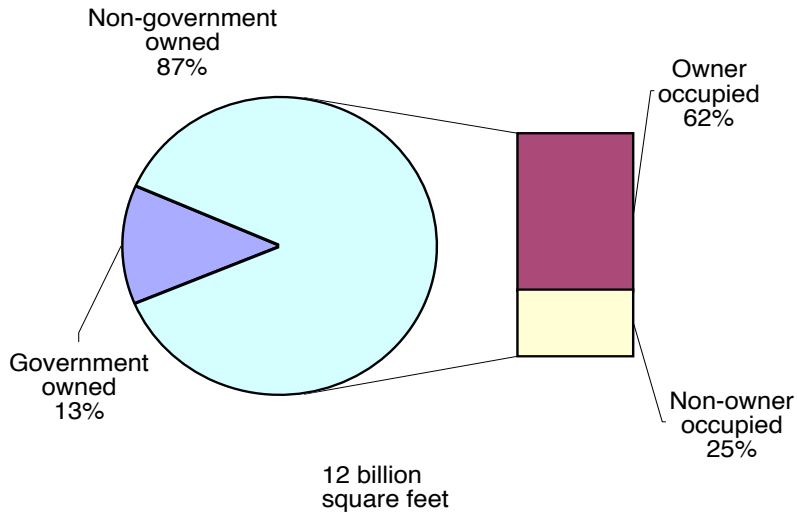
Ignoring vacant premises, the public (or governmental sector) accounts for about 13 percent of office floor space and the private sector 87 percent (Figure 31). The private sector non-owner occupied space is about 25 percent of the total floor space or about 29 percent of private sector space. Owner occupied floor space is by far the largest percentage of the total market (62 percent).



Source: EIA, CBECs Data, Table B-12 1999

Figure 30 Number and ownership of office buildings in the United States

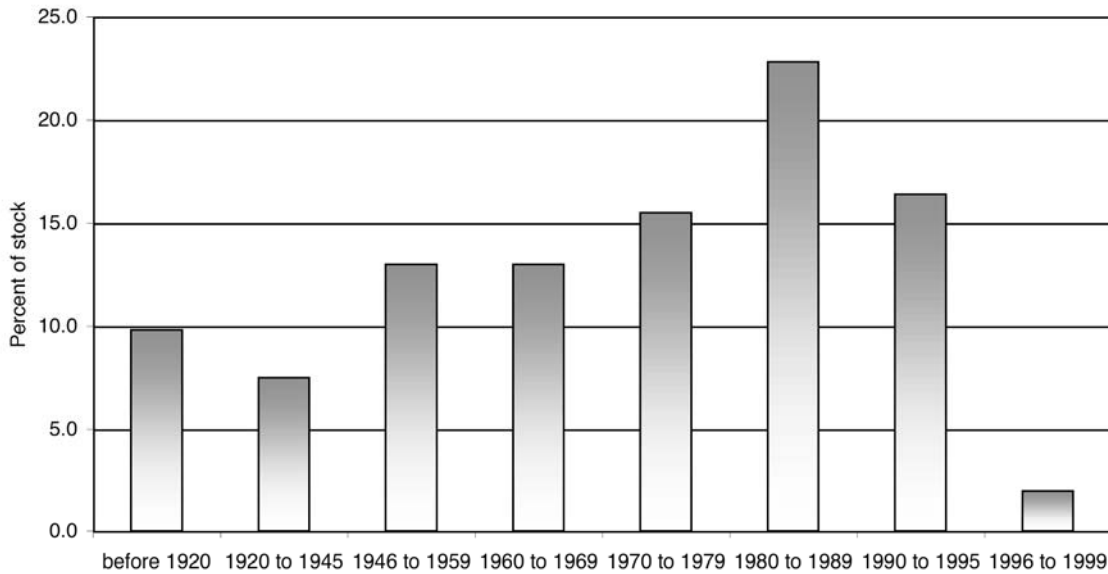
The ownership breakout is important because many in the energy field tend to think of the office sub-market in terms of leased space. In fact, the majority of the space is owner occupied. This means that for the majority of buildings, energy program implementers will be targeting an owner who provides the capital and uses the space rather than some other decision maker.



Source: EIA CBECS Data. 1999

Figure 31 Ownership and occupancy in the office sub-market of the commercial building market (12 billion square feet)

Relative to other commercial buildings, office structures tend to be newer. Fifty-eight percent of buildings have been built since 1970 (Figure 32) compared to less than 50 percent for other commercial buildings (Figure 12). There was a great deal of office construction in the late 1980s and early 1990s as well as a downturn in the economy that led to a glut of office space in the market in the early to mid 1990s. With improvements in



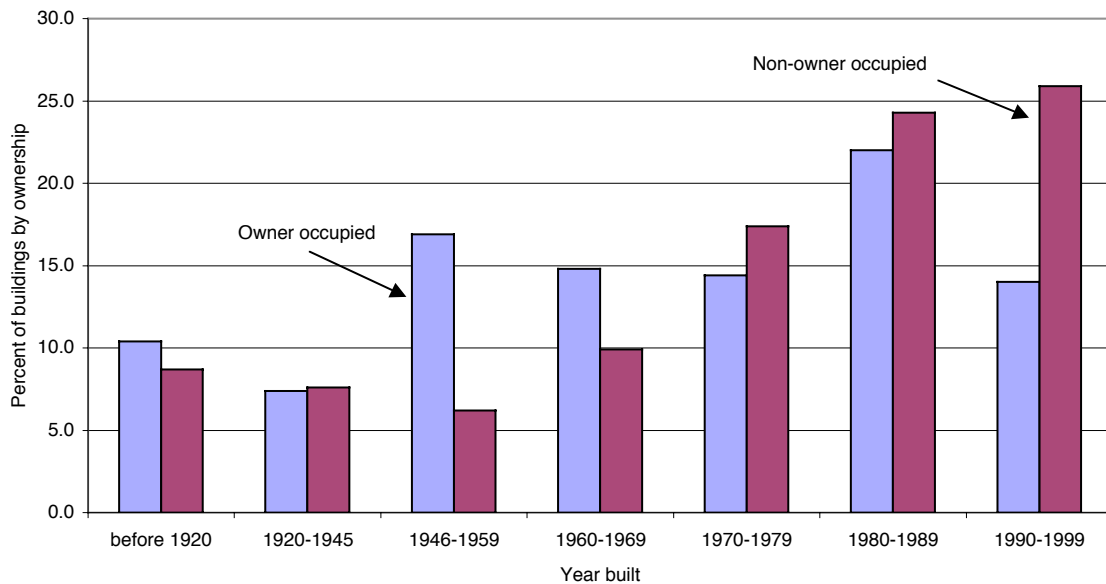
Source: Analysis of CBECS use sample 1999 by Innovologie, LLC.

Figure 32 Percent of office building stock by year built

the economy, this surplus of office space disappeared in the late 1990s only to reappear after 2002 with changing economic fortune.

Owner and non-owner occupied office buildings

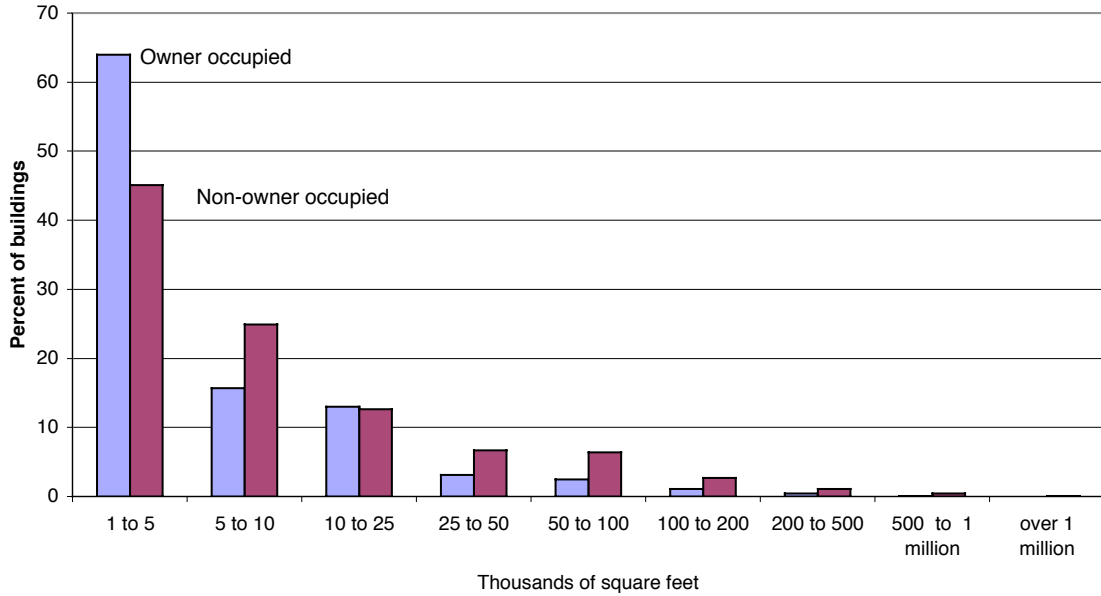
Owner and non-owner occupied office buildings vary with respect to a number of key characteristics. Buildings built prior to 1970 tend to be owner occupied. Buildings built after 1970 tend to be non-owner occupied. This shift to non-owner occupied buildings was particularly noticeable in the 1990s. In part, this reflects the philosophy of some larger companies of focusing on their core business and staying out of the real estate business in which they do not have expertise. Leasing also makes it easier for large firms to scale their space to the number of employees. It is unclear whether the trend toward leasing will continue in the future but it seems likely.



Source: EIA, CBECs public use sample, 1999 as analyzed by Innovologie, LLC

Figure 33 Percent of office buildings by age and ownership

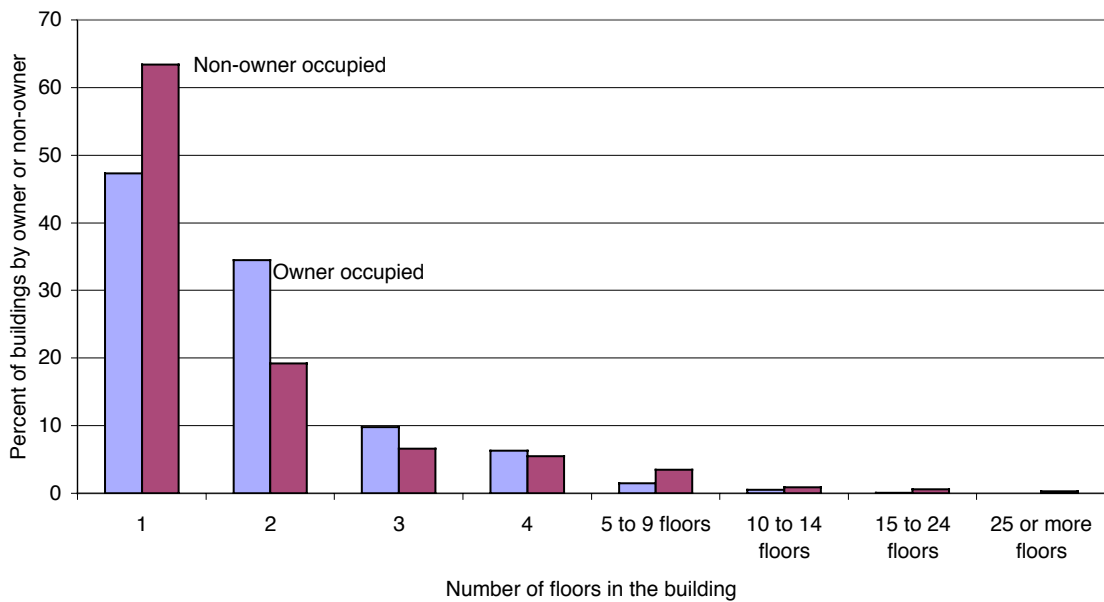
Owner occupied buildings tend to be smaller than non-owner occupied buildings (Figure 34). Sixty-four percent of owner occupied buildings compared to 45 percent of non-owner occupied buildings have total areas of less than 5,000 square feet. Seventeen percent of non-owner occupied buildings are more than 25,000 square feet compared to seven percent of owner occupied buildings. The very largest buildings tend to be leased buildings.



Source: EIA, CBECS, 1999 as analyzed by Innovologie, LLC

Figure 34 Percent of buildings by size category and ownership

The structures of buildings vary by ownership as well (Figure 35). Non-owner occupied buildings are more likely to be single story buildings or five floors or more. In contrast to non-owner occupied buildings, owner occupied buildings are more likely to be two to

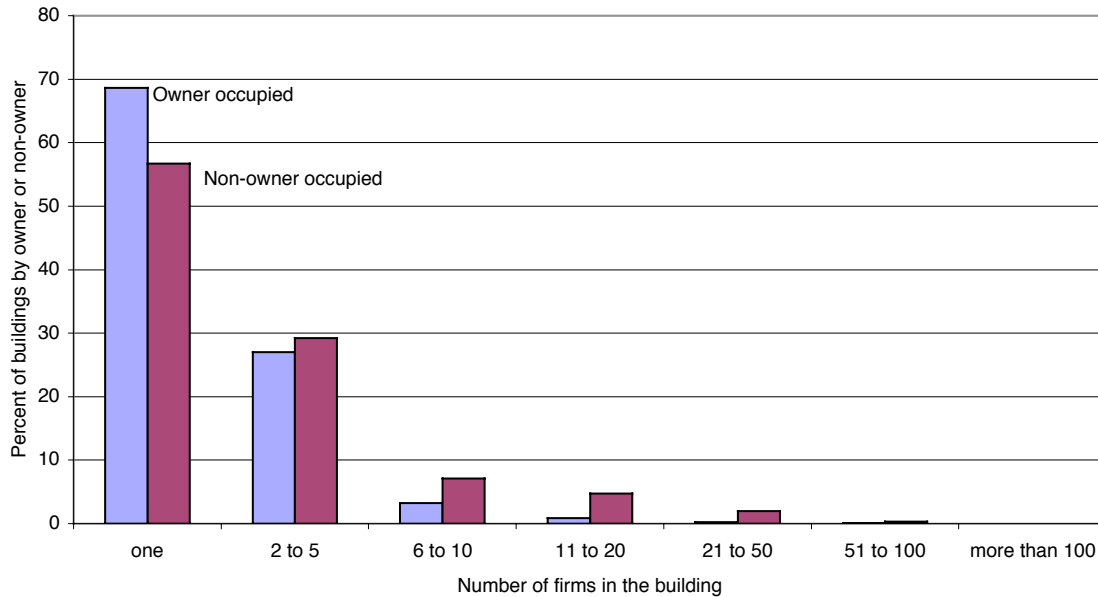


Source: EIA, CBECS public use sample, 1999 as analyzed by Innovologie, LLC

Figure 35 Percent of office building ownership by number of floors

four-story buildings than other heights. The fact that so many non-owner office structures are single story may be a result of the construction of a large number of single story office buildings in suburban office parks in the 1980s and 1990s.

The majority of office buildings are single tenant buildings (Figure 36). Owner occupied buildings are more likely (68 percent) than non-owner buildings (55 percent) to be single tenant buildings. Not surprisingly, non-owner occupied office buildings are more likely to have additional tenants and to have more tenants than owner occupied office buildings.



Source: EIA, CBECS public use sample, 1999 as analyzed by Innovologie, LLC

Figure 36 Percent of ownership of office buildings and the presence of other tenants

The Leased office sub-sector

There is another important story with respect to the leased office sector. A few large firms build much of the leased office space. Table 13 shows the top 25 developers of office space in 2002. Trammell Crow, the leading office developer in 2002, developed almost 14 million square feet. The Hines Company (13.5 million square feet) was close behind Trammell Crow. Two other firms had more than five million square feet under development. Together, the top 25 developers had more than 76 million square feet under development.

Based on the CBECS data, approximately 1.1 billion square feet of office lease space was built in the 1990s, which computes to an average of about 108 million square feet annually. During the 1990s when developers were particularly active, the top 25 developers may have developed as much as 120 to 130 million square feet in some years. Using the annual average in the 1990s as a basis, the 2002 top 25 developers developed about 70 percent of the new leased office space that was built in 2002. If the estimates for other recent years are similar, then the top 25 developers are developing a significant percentage of the total office lease space. Because they account for so much of newly con-

structured office space, the top 25 developers are an important key to improving energy efficiency in new office buildings.

Table 13 Square footage of office space under development by the top 25 office developers in the United States in 2002

Rank	Company name	Headquarters city	State	Millions of square feet
1	Trammell Crow Co.	Dallas	TX	13.90
2	Hines	Houston	TX	13.50
3	The Opus Group	Minnetonka	MN	9.50
4	Brookfield Properties Corp.	New York	NY	7.80
5	The Alter Group	Skokie	IL	4.10
6	Spaulding & Slye Colliers	Boston	MA	3.70
7	Higgins Development Partners	Chicago	IL	3.20
8	ING Clarion	New York	NY	2.98
9	Carter & Associates ONCOR International	Atlanta	GA	2.40
10	Mack-Cali Realty Corp.	Cranford	NJ	2.30
11	Lincoln Property Co.	Dallas	TX	1.80
12	Equity Office Properties Trust	Chicago	IL	1.80
13	The Gale Co.	Florham Park	NJ	1.79
14	Transwestern Commercial Services	Houston	TX	1.40
15	McShane Corp.	Rosemont	IL	1.20
16	Holder Properties	Atlanta	GA	1.00
17	Duke Realty Corp.	Indianapolis	IN	0.98
18	ORIX Real Estate Equities Inc.	Chicago	IL	0.98
19	Patrinely Group LLC	Houston	TX	0.79
20	CarrAmerica Realty Corp.	Washington	DC	0.68
21	RREEF	San Francisco	CA	0.65
22	Legacy Partners	Foster City	CA	0.57
23	CB Richard Ellis Investors LLC	Los Angeles	CA	0.56
24	Liberty Property Trust	Malvern	PA	0.50
25	HSA Commercial	Chicago	IL	0.50
	Total			78.6

Source: National Real Estate Investor On-Line

Developers may construct properties but that does not necessarily mean that they own what they build. Table 14 lists the 2002 top 25 owners of leased office space in the United States. Equity Office Properties Trust is the largest owner with 125 million square feet followed by Hines with about a third of that amount of space followed by several firms that owned between 25 and 30 million square feet. Combined, these firms owned about a half a billion square feet of office space. If the total square footage of leased office space in the United States was about 2.9 billion square feet, then these top 25 owners owned approximately one-sixth of the commercial lease office space. In terms of increasing the energy efficiency of office space, these owners are an important target.

Table 14 Office space owned by the top 25 office owners in the United States in 2002

Rank	Company name	Headquarters city	State	Millions of square feet
1	Equity Office Properties Trust	Chicago	IL	124.6
2	Hines	Houston	TX	47.6
3	LaSalle Investment Management	Chicago	IL	29.2
4	Mack-Cali Realty Corp.	Cranford	NJ	28.8
5	Duke Realty Corp.	Indianapolis	IN	25.6
6	ING Clarion	New York	NY	25.5
7	CarrAmerica Realty Corp.	Washington	DC	25.2
8	Lincoln Property Co.	Dallas	TX	25.0
9	Shorenstein Co. LLC	San Francisco	CA	21.0
10	Liberty Property Trust	Malvern	PA	17.0
11	CB Richard Ellis Investors LLC	Los Angeles	CA	17.0
12	Brookfield Properties Corp.	New York	NY	16.6
13	RREEF	San Francisco	CA	16.1
14	Prentiss Properties	Dallas	TX	15.3
15	Brandywine Realty Trust	Plymouth Meeting	PA	14.5
16	Hartz Mountain Industries Inc.	Secaucus	NJ	12.8
17	The Alter Group	Skokie	IL	11.4
18	CMD Realty Investors	Chicago	IL	10.5
19	The Opus Group	Minnetonka	MN	9.9
20	Insignia/ESG Inc.	New York	NY	6.5
21	The Gale Co.	Floram Park	NJ	6.4
22	Legacy Partners	Foster City	CA	5.5
23	Harbor Group International LLC	Norfolk	VA	4.8
24	Advance Realty Group	Bedminster	NJ	4.2
25	The Ashforth Co.	Stamford	CT	4.2
	Total			525.2

Source: National Real Estate Investor On-Line

Classes of office buildings in the commercial lease sub-sectors

Owners, investors and operators in the office sub-market use three general classifications, Class A, Class B, and Class C, to distinguish different types of buildings. The classification is based on investment potential that is largely defined by a building's quality, care, and location.

Class A buildings are highly desirable investment grade properties that command the highest rent or sales price compared to other buildings in the same market. Such buildings are in attractive locations, have efficient tenant layouts, are of quality and may have unique one-of-a-kind floor plans. Class A buildings may be architectural or historical landmarks designed by prominent architects. These buildings contain modern mechanical systems, have above average maintenance and management, and have the best quality

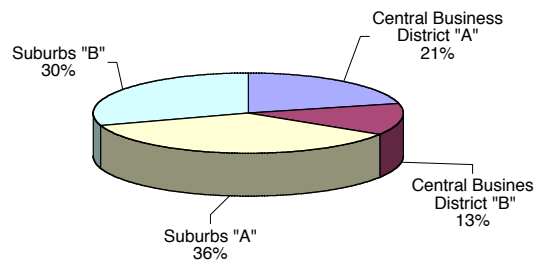
materials and workmanship in their trim and interior fittings. Tenants and investors willing to pay a premium for office space seek these buildings.

Compared to Class A properties, Class B buildings are a more speculative investment and command correspondingly lower rents and/or sales prices. Class B buildings of recent vintage offer utilitarian space, ordinary design, or good to excellent design if the building is older and not a landmark. Maintenance, management, and the prestige of tenants are average to good in these buildings. They are less appealing to tenants than Class A properties. These buildings may have hard-to-work-with floor plans, lack desirable functionality such as fiber optic cabling, and be in less desirable condition. Their lower rents and cost may make them attractive to certain types of tenants and investors.

Class C buildings are generally no-frills older buildings that offer basic space and command lower rents or sales prices. Such buildings typically have below average maintenance and management and can have mixed or low tenant prestige, inferior elevators, and/or mechanical/electrical systems. These buildings lack prestige and depend on low rents or low cost per square foot to attract tenants and investors.

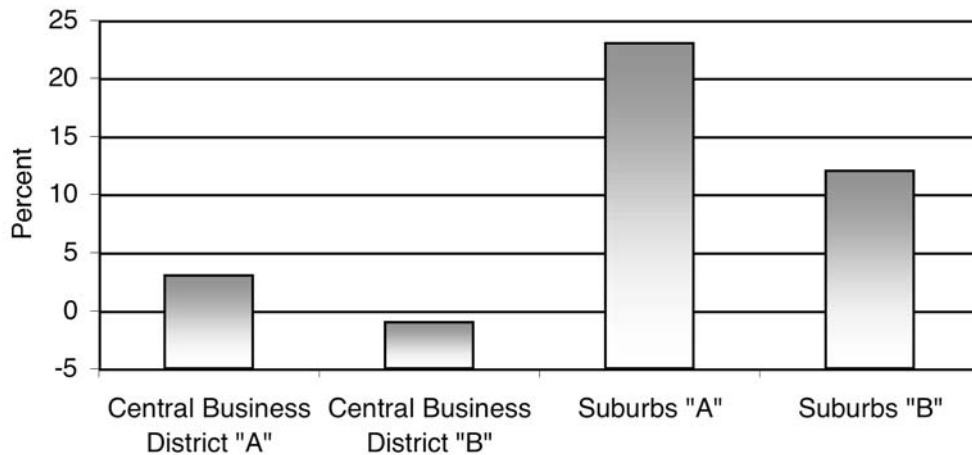
Figure 37 shows that most of the Class A and B lease space tends to be in the suburbs. This is not surprising given the spread of the interstate highway system and the level of commercial construction in the suburbs since World War II.

There is an interesting recent trend that suggests that the focus may be shifting away from the suburbs. Net absorption is the difference between the square footage of property that is available and the property that is constructed. At the present time, the net absorption rate in downtown areas is very low compared to net absorption in suburban areas. This means that property in downtown areas is being absorbed more quickly than property in the suburbs. There is some evidence that there is a movement of offices to central district business spaces and the retention of existing offices. Some of this may be a function of the shakeout from the “dot.coms” that tended to locate in suburban areas. It will be important to see if this trend continues once the current economic slowdown passes.



Source: 2002 SIOR Comparative Statistics of Industrial and Office Real Estate Markets

Figure 37 Classes of office buildings by urban or suburban location



Source: 2002 SIOR Comparative Statistics of Industrial and Office Real Estate Markets

Figure 38 Net absorption by office building class and location

Volatility in the commercial office sector

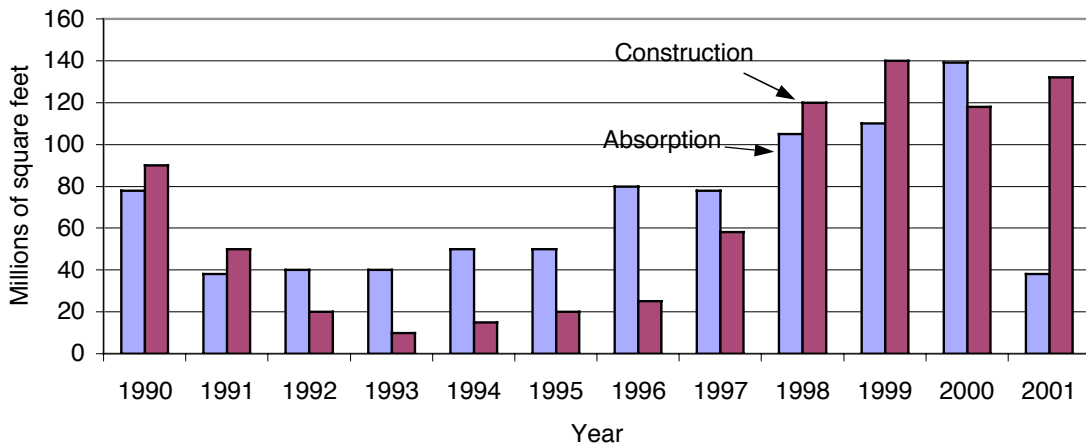
In the previous chapter we noted that the new construction market is subject to ups and downs. Part of this is due to the volatility in the commercial office sector. In periods of economic expansion, the demand for office space expands and in periods of economic contraction, it declines. At least in the last two decades, there have been periods when developers have badly overestimated the future demands for office space. This has resulted in large amounts of vacant space that must then be absorbed. In a slow economy it may take several years to actually fill the available space. During this period there may be movement among spaces as tenants take advantage of the surplus and the generally reduced rents or advantageous lease terms.

The reason for the lags is inherent in financing, design, and construction cycle. Financing is committed in the front-end of a project based on the business plan and the conceptual plan for the building. Financing packages can be quite complicated, involve many business partners and government agencies, and include a large number of detailed agreements. Thus, there are very strong incentives to maintain the financing agreements without change because changes would require extensive renegotiation. Once the business plan, the conceptual plan, and the financing are in place, it may take several months to complete land contracts, obtain permits, and develop detailed specifications and plans. It can be two or three years from financing to the actual completion of a project.

The incentives for developers and investors are to stay with the plan, but the economy can change and along with it the demand for office space. Thus, what is being built and demand can become out of phase with each other.

As noted above, absorption is the amount of vacant space that is occupied during the year. Absorption can be greater than the amount of newly constructed space because already existing space is also available for occupancy. Likewise, absorption can be less than the newly constructed space if more space is being constructed than is being used.

Figure 39 shows absorption and office construction for the period 1990 to 2001. In 1990 and 1991, more office space was being built than was being absorbed, meaning that empty space had to be absorbed in the future. This was the tail end of a construction boom in the late 1980s. In the middle 1990s, more office space was being absorbed than was being built. This was the period during which the space that became available as a result of the construction boom in the late 1980s and early 1990s was becoming fully utilized. Starting around 1998, the absorption of office space was generally less than that being constructed meaning that another construction cycle had begun in response to the economy.



Source: 2002 SIOR Comparative Statistics of Industrial and Office Real Estate Markets

Figure 39 The net absorption and construction of office space

By 2001 the absorption rate was the lowest it had been in the previous 10 years. Some have argued that the increase in office space in 2001 was not caused by overbuilding, but rather by the emptying out of the leased office market, due in large part to the 2000-2001 recession. According to the Statistics of the Industrial and Office Real Estate Market (SIOR) Survey, 125 million square feet of ‘leased space’ was returned to the market. This was “tantamount to a doubling of the year’s construction volume, and totally blindsided the real estate community with the magnitude and speed of its emergence.”¹¹¹ Although we do not yet have the data for 2002, it appears that at least the shells of projects in process were continued to completion, and there has been a continued emptying of ‘leased space’. Thus, we suspect that the 2002 construction figures will be high relative to the absorption of space.

There are several key points to be made here. First, it takes time to get office projects sited, financed, designed, and into the market. Thus, the timing of construction may not always correlate well with demand. In turn, this may influence the willingness of owners and developers to use energy efficient technologies. In the upside of the cycle, owners and developers may be in a rush to complete projects and may not be willing to take time to consider new energy efficiency technologies. Likewise, architects and engineers may be in a hurry to complete projects and less interested in new and innovative technologies.

¹¹¹ 2002 SIOR Comparative Statistics of Industrial and Office Real Estate Markets

Thus, the time to approach developers, architects, and engineers may be in the down side of a cycle. Further, in the downside of the cycle there may be a great deal of space that is enclosed but not built out. Thus, while some technology options may be foreclosed (efficient glass and external shading devices), there may still be time to revise technology plans (lighting, controls, and HVAC systems) for space that is yet to be built out, especially if new technologies can be introduced at the same or nearly the same cost as the older technologies.

If one wants to get new technologies into the market, it is probably important that the technologies be employed in the downside of the cycle so that they are there and accepted in time for the design phase of the boom part of the cycle.

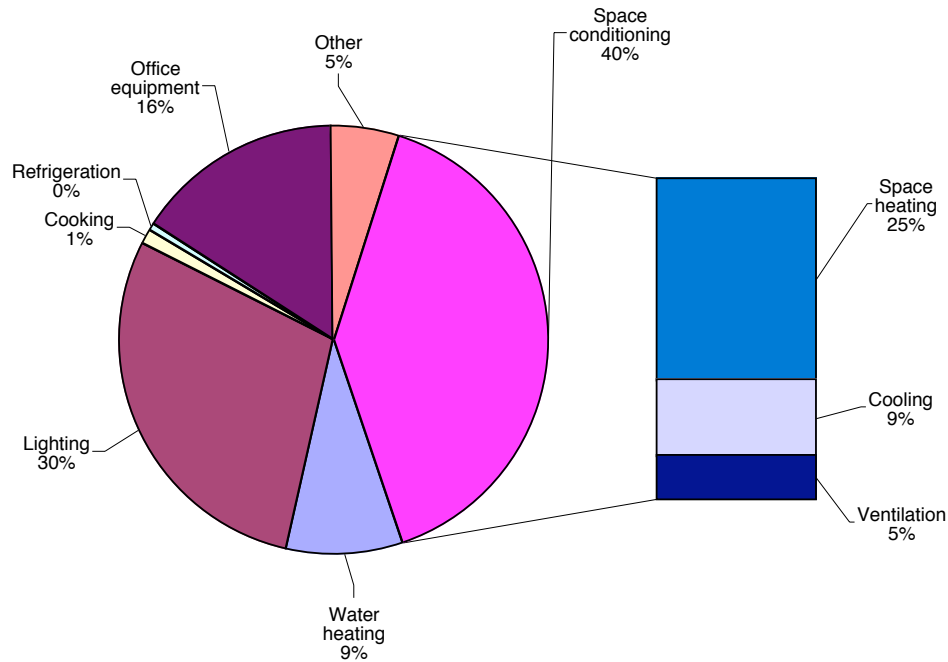
There are of course some potential glitches in this scenario. In the downside of the cycle, investors, owners and developers may not be willing to put additional capital into projects because of the fear of high short-term vacancy rates although potential tenants may be in a position to demand more. It is important to know more about the effects of these cycles, their effects on technology choices, and the willingness of developers, architects and others to innovate and try new technologies.

Energy end-use in the office sub-market

In the commercial building sector, the largest proportion of energy is used for space conditioning (40 percent). Within space conditioning, space heating is the largest percent, 25 percent of all office energy use, followed by cooling (nine percent) and ventilation (five percent).

Some readers may be surprised that the space heating energy use is more than twice that of the cooling energy use. It is important to keep in mind that these data are national level data. Thus, they include data for buildings in northern climes as well as southern and western climes. Further, when we think about office buildings, we often think about large buildings with glass facades. While this is the image, the reality is really one of many smaller buildings with relatively small amounts of glass. Thus, space heating is a major load in many office buildings.

After space conditioning, lighting is clearly the most intensive energy use followed by office equipment and then water heating. When combined, cooking and refrigeration are less than two percent of the energy used in commercial buildings.



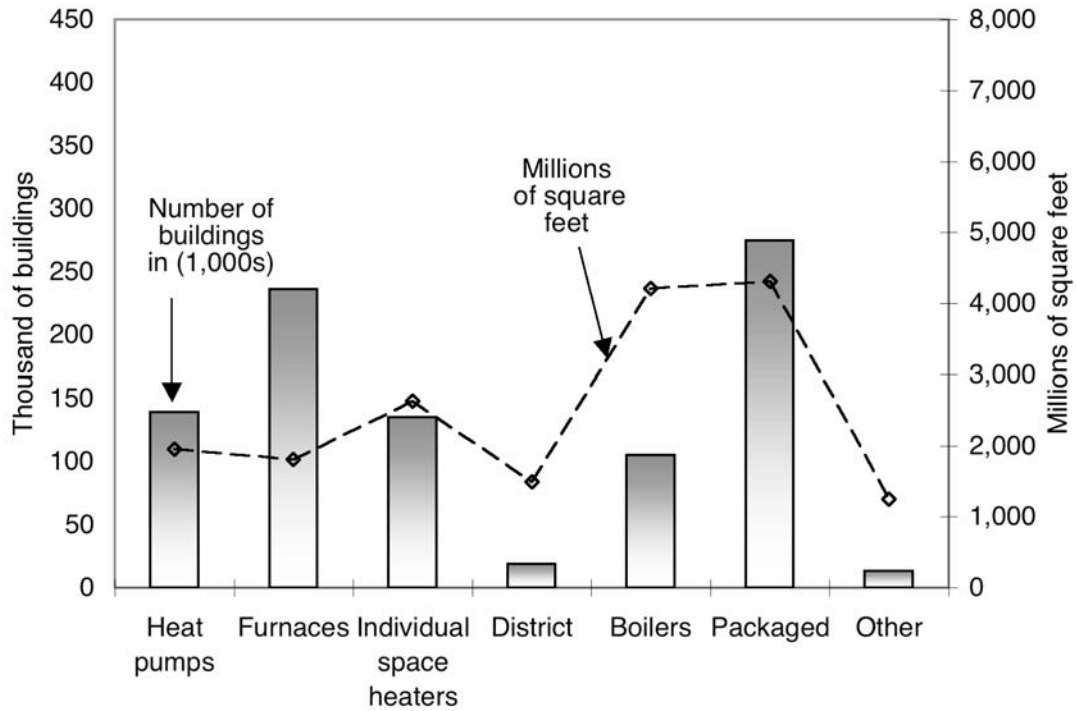
Source: EIA, CBECS, 1995, Table EU-4

Figure 40 End-use intensities in office buildings

Heating and cooling equipment

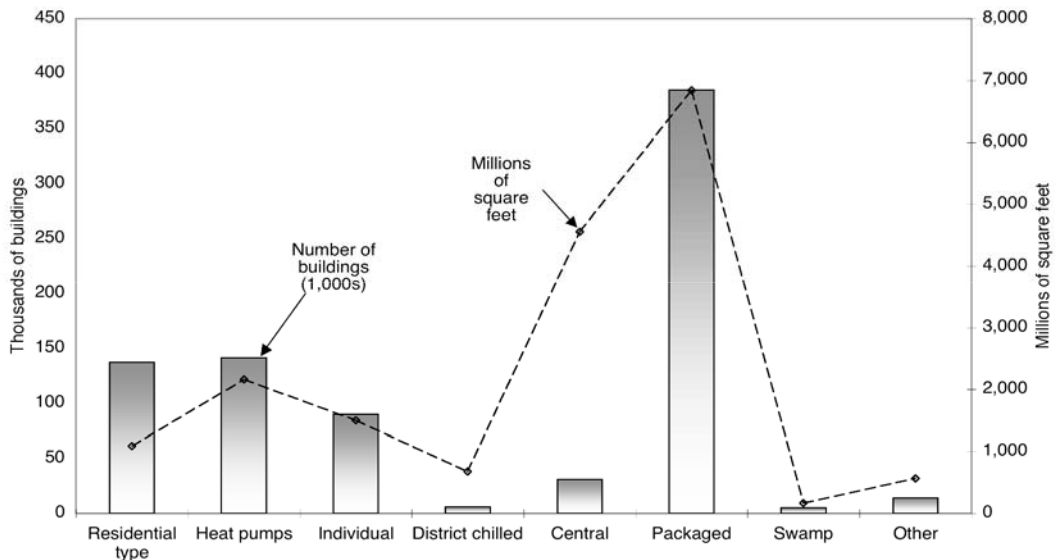
In the office sub-market, nearly all of the commercial office floor space is heated (98 percent) and cooled (97 percent). In terms of total floor space, the most commonly installed types of heating equipment are boilers (35 percent) and commercial packaged systems (36 percent). However, in terms of the number of installed packaged units, furnaces and space heaters are the most common. The differences in these distributions reflect the dichotomy between the larger and smaller office buildings.

There is a somewhat similar dichotomy with respect to air conditioners. Packaged systems are used to cool 58 percent of the total floor space followed by central systems that cool 39 percent of the floor space. Packaged systems are found in more than half of the buildings but central systems are found in less than five percent. Thus, central systems cool large amounts of space in a relatively small number of buildings.



Source: EIA, CBECS Tables B32-B33; More than one type of air conditioning can exist in the same space. The sum of the values will exceed the number of buildings and the total square feet.

Figure 41 Types of Heating Equipment Installed in the Office Sub-Sector

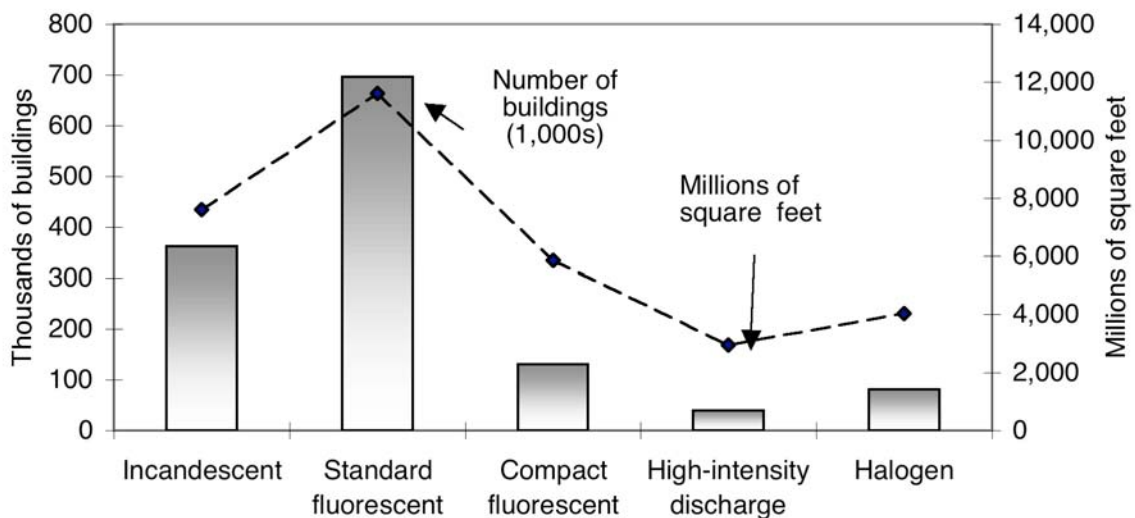


Source: EIA, CBECS Tables B34-B35; More than one type of air conditioning can exist in the same space. The sum of the values will exceed the number of buildings and the total square feet.

Figure 42 Types of cooling equipment installed in the office sub-sector

Lighting equipment

Nearly all the floor space in the commercial office market (99 percent) has some lighting. Buildings with 96 percent of the total office floor space have at least some standard linear fluorescent fixtures. Buildings that account for about half of the office floor space have compact fluorescents in them. Incandescent lamps can be found in office buildings that account for about 63 percent of the total floor space. High-intensity discharge and halogen lamps can be found in buildings accounting for 24 and 34 percent of the total floor space. Compact fluorescents, high intensity discharge, and halogen lighting are found in greater proportions of floor space than in the proportion of buildings. This suggests that these technologies are more likely to exist in larger and perhaps newer buildings.



Source: EIA, CBECS 1999 Tables B38-B39

Figure 43 Types of lighting equipment installed in the office sub-market

Efficiency measures

Over the last 20 years many buildings have had more efficient equipment installed in them. Table 15 shows the total square footage of office space in which at least some of the space has the identified efficiency measure. The square footage affected by the measure may be somewhat less than the square footage of the buildings. Electronic ballasts, which would imply more efficient lighting than standard fluorescents, are found in almost three-quarters of commercial office space. According to this data, specular reflectors are found in office buildings representing about 42 percent of the space. Other efficiency measures, such as energy management systems, are found in buildings representing about half of the total commercial office space. While energy management systems are found in buildings representing about half of the office space, we do not know to what extent the energy management systems are being used. If these figures are accurate,

it would appear that there has been substantial penetration of efficient equipment into the office sector.

Office sub-market summary

In 1999, there were 739,000 office properties in the US accounting for roughly 12 billion square feet. Sixty-two percent of this space was owner occupied. Office buildings tend to be newer than other kinds of commercial buildings. Fifty-eight percent of office buildings have been built since 1970 compared with less than 50 percent of buildings in other commercial sub-markets.

Table 15 Square footage and percentage of total square footage of buildings that have energy efficiency measures

Measure	Billions of square feet for buildings having the measure	Percent of total office square feet (12 billion)
Electronic ballasts	8.7	73
Economizer cycle	6.3	53
Variable air volume systems	6.0	50
Energy management systems	5.7	48
Multi-paned windows	5.8	48
Specular reflectors	5.0	42

Source: EIA, CBECS public use sample, 1999 as analyzed by Innovologie, LLC. Square footage is the square footage for buildings having the measure. Not all of the space in a building may have the measure.

Pre-1970 office buildings tend to be owner occupied. Buildings built after 1970 tend to be non-owner occupied. Since the 1970s, there has been a trend for companies to lease rather than to own buildings. This trend was particularly noticeable in the 1990s. This may reflect a business strategy of focusing on core business activities and avoiding distractions such as real estate operations. It also enables firms to be flexible in their space demands.

Owner occupied buildings are smaller. They are more likely to be low rise with the exception of single story buildings that are relatively more likely to be leased. In comparison to non-owner occupied buildings, owner occupied buildings are more likely to be single tenant buildings and when multiple occupants are present to have fewer tenants than non-owner occupied buildings.

In the 1990s, about 108 million square feet of new office space was built annually. On an annual basis as much as 70 percent of this space may have been developed by the top 25 office developers. The top 25 commercial property owners own approximately half a billion square feet which is approximately a sixth of commercial office lease space. Thus, a large percentage of new construction is done by a relatively small number of firms and ownership of lease space is highly concentrated as well.

Before leaving this chapter, it is important to make some notes about energy using equipment in the office sub-market. Although utility programs have tended to focus on air conditioning, space heating is a significant end-use. There are large numbers of furnaces in use. Packaged units are a very important technology for both heating and cooling, especially given the large number of smaller spaces. This may continue to be the case in the future.

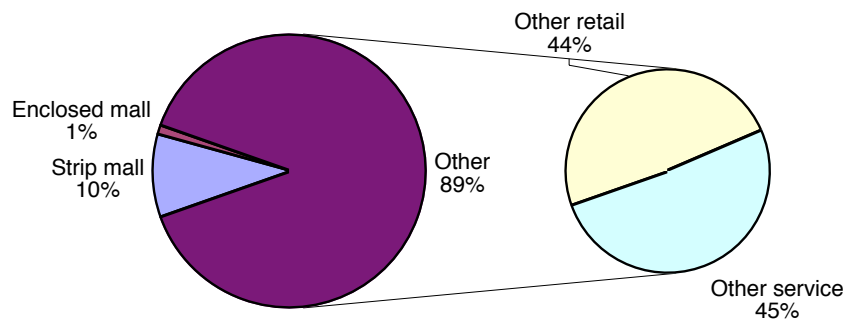
Finally, it appears that efficiency measures are penetrating this sector. Substantial percentages of floor space appear to have efficient technologies installed in them.

Chapter 6 The Retail and Service Sub-Market

Introduction

There are approximately 1.29 million retail and service buildings in the United States (Figure 44).¹¹² This sub-market is housed in three basic types of buildings:

- Retail in enclosed malls (about 1 percent)
- Retail and service establishments in strip malls (about 10 percent)
- Other retail and service establishments in multi-use buildings or standalone structures usually found in central business districts or “main street” locations but also at dispersed locations (about 89 percent)

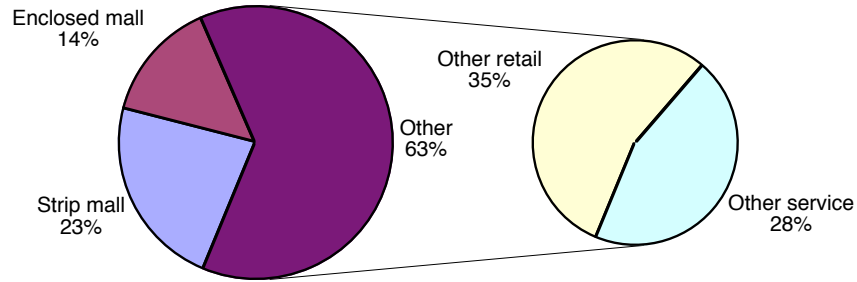


Source: EIA, CBECS, 1999, Table B-11

Figure 44 Location of establishments as a percent of total buildings (1.29 million establishments) in the retail and service market

The picture shifts just slightly if one examines floor space (Figure 45). Establishments in strip malls account for approximately one-quarter of commercial retail space while establishments in enclosed malls account for approximately 14 percent. The remaining 63 percent of space is accounted for by other retail and service establishments with retail establishments tending to dominate. Thus, the largest number of retail and service establishments and the largest amount of retail space are found outside of malls and strip malls.

¹¹² The International Council of Shopping Centers (ICSC) describes malls or enclosed malls as a “climate-controlled walkway between two facing strips of stores. The term represents the most common design mode for regional and super-regional centers and has become an informal term for these types of centers.” Strip malls are typically described as being a “coherent retail entity” with parking in front of stores, perhaps having canopies, and configured in a straight line, ‘L’, or ‘U’ shape.



Source: EIA, CBECS, Table B12, 1999

Figure 45 Distribution of floor space in retail and service markets (12.7 billion square feet)

The ownership, size, and age of other retail service establishments

Analysis of the CBECS public use sample data provides some insight into the ownership and composition of at “other retail” and the “other service” sub-markets. Whereas, much of the occupancy in malls and strip malls is based on leases, approximately sixty percent of establishments in the “other retail” and “other service” categories (Table 16) are owner occupied. In buildings that are owner occupied (Table 17), the owner is the sole tenant more than 90 percent of the time. Lessees are the sole tenants 75 percent of the time. Less than two percent of “other retail” and “other service” buildings have more than five tenants.

Table 16 Percentage of “other retail” and “other service” establishments that are owner-occupied or leased

	Other retail	Other service	Enclosed malls	Strip malls
Percent owner occupied	59.5	63.2	37.5	26
Percent leased	40.5	36.8	62.5	74
N	526,729	462,142	2,771	130,569

Source EIA, 1999 CBECS Public Use Sample, as analyzed by Innovologie, LLC.

Most of the “other retail” and “other service” establishments have small foot prints (Table 18). Sixty percent of the “other retail” and “other service” establishments have buildings that are less than 5,000 square feet in size. Eighty-six percent of “other retail” and 97 percent of “other service” establishments have 25,000 square feet or less. Also, the buildings are predominantly low-rise buildings. Seventy-three percent of the “other service” buildings and fifty-three percent of the “other retail” buildings are single story buildings. Ninety-nine percent of all such establishments are in buildings of three floors or less.

Slightly more than half of the other retail buildings are more than 40 years old (Table 19). Retail service buildings are newer; only 39 percent are more than 40 years old. However, 54 percent of the enclosed malls and 79 percent of the strip malls are less than 40 years old. Strip malls were mostly built in the 1970s and 1980s. In the 1990s, the number of other retail and service establishments that were constructed was about half that of the 1970s and 1980s. Malls continued to be constructed at about the same pace as in the 1980s, but strip malls were constructed at about a third of the pace as in the 1980s.

Table 17 Number of establishments in “other retail” and “other service” buildings

Number of firms in the building	Owner occupied		Occupied by lessees	
	Other retail	Other service	Other retail	Other service
One	90.5	76.7	77.6	76.6
2 to 5	7.5	23.2	21.3	23.2
6 to 10	1.8	0	.8	.3
11 to 20	2	0	0.2	0
More than 20	0	0	0.2	0
Total	100	99.9	100.1	100.1
N	313,813	298,296	213,544	173,847

Source: EIA, 1999 CBECS public use sample, as analyzed by Innovologie, LLC.

Table 18 Percentage of “other retail” and “other service” establishments by category of square feet

Total square feet	Other retail	Other service
Less than 5,000	58	61
5,001 to 10,000	19	27
10,000 to 25,001	19	9
25,001 to 50,000	2	2
50,001 to 100,000	1	1
100,001 to 200,000	1	0
200,001 to 500,000	0	0
500,001 to 1 million	0	0
Greater than 1 million	0	0
Total	100	100
N	533,589	478,211

Source: EIA, 1999 CBECS public use sample, as analyzed by Innovologie, LLC.

Retail and services roles in the U.S. economy

It is difficult to sort out exactly what types of establishments tend to be in the other retail and other service sub-markets. By looking at the general picture and comparing the general picture to what we know about malls and strip malls, we can get a better idea.

According the U.S. Census Bureau (Table 20), retail and service businesses account for 42 percent of the total revenue from non-government businesses. The services sub-market now accounts for more than one-quarter (27 percent) or \$6.1 trillion of all U.S. business revenue.

There is significant diversity in the retail and service sub-markets. Table 21 and Table 22 display retail and services revenues by category.

Sales in the retail and service sub-markets are dominated by durable goods such as automobiles, furniture, electronics, and appliances (35 percent of total retail revenue).

Table 19 Percentage of retail and other services establishments by year constructed

Year constructed	Other retail	Other service	Enclosed malls	Strip malls
Before 1920	17	4	11	<1
1920-1945	9	16	16	11
1946-1959	26	19	8	11
1960-1969	8	14	20	12
1970-1979	15	19	18	26
1980-1989	17	19	13	30
1990-1995	6	9	6	9
1996-1999	2	1	7	2
Total	100	100		
N	533,590	478,211	2,771	130,658

Source: EIA, 1999 CBECS public use sample, as analyzed by Innovologie, LLC.

Table 20 Services and retail revenue in the U.S.

Summary	Revenue in billions	Percent of total
Services	\$6,085.8	27
Retail	\$3,435.5	15
All Industries	\$22,594.1	100

Source: © 2003 BizStats.com accessed July 17, 2003

Table 21 Retail revenues by type

	Revenues in billions	Percent of total	Category percent
Durable Goods			34.7
New and used car dealers	780.2	22.7	
Other motor vehicle and parts dealers	147.7	4.3	
Electronics and appliance stores	166.3	4.8	
Furniture and home furnishings stores	100.2	2.9	
Merchandise			28.3
General merchandise stores	542.0	15.8	
Clothing and clothing accessories stores	181.1	5.3	
Sporting goods, hobby, book, and music stores	86.8	2.5	
Health and personal care stores	160.2	4.7	

	Revenues in billions	Percent of total	Category percent
Food and beverage			15.8
Food and beverage stores	491.8	14.3	
Beer, wine, & liquor stores	16.5	0.5	
Miscellaneous store retailers	214.0	6.3	6.3
Building, home and Garden			6.0
Homes centers; paint and wallpaper stores	78.8	2.3	
Hardware stores	29.2	0.8	
Other building material dealers	81.8	2.4	
Lawn & garden equipment & supplies stores	15.8	0.5	
Gasoline stations	158.5	4.6	4.6
Nonstore retailers	139.0	4.0	4.0
Retail trade	3,435.5 ¹		

¹ There is a discrepancy of \$45.6 billion in the sum of this column of figures and the sum for retail trade reported in the on-line source. It is unclear whether there is a missing category or the reported total is erroneous. We were unable to resolve this discrepancy. Source: 2003 BizStats.com, accessed July 17, 2003

The merchandise and food and beverage sectors follow. The merchandise sector, including general merchandise stores, clothing, sporting goods, and health and beauty, account for \$1 trillion in revenues or approximately 28 percent of total retail revenues.

The services sub-market is dominated by finance and insurance and then profes-

sional and business services. Finance represents about two-thirds of the service sector and professional and business services another 23 percent of the total revenue in the sub-market. Many of the services provided by the service sub-market are provided in office-like settings (Table 23).

According to the Census Bureau, the retail and services sub-markets account for 28 percent of the total employment of all non-government industries. Of this, about nine percent of all employees work in the retail sub-market and 19 percent of all employment is in service-related businesses.

Table 22 Service revenue by type

Category of services	Revenue in bil- lions of dollars	Percent of Total
Finance and insurance	\$3,963	65
Professional and business services	\$1,403	24
Real estate	\$244	4
Other services	\$235	4
Arts, entertainment, and recreation	\$124	2
Rental and leasing services	\$117	2
Total services revenue	\$6,086	
Total revenue for U.S. industries	\$22,594	
Services as a percent of total U.S. revenue		27

Source: 2003 BizStats.com, accessed July 17, 2003

Table 23 Employers and employment in retail and services

Total employment in retail and service sub-sector	Total number of employers	Percent of employers	Total employment	Percent of employment	Average employee count per firm
Retail	621,469	11	9,614,419	9	15.47
Services	1,291,060	23	21,368,571	19	16.55
Arts/entertainment	10,855	<1	221,625	<1	20.42
Total	1,923,384		31,204,615		17.48
Total U.S.	5,607,743	34	110,705,661	28	19.74

Source: 2003 BizStats.com, accessed July 17, 2003

Thus, the bottom line is that owners mostly occupy other retail and other service buildings. These establishments have relatively small amounts of square footage and the buildings tend to be older. The data also suggest that buildings that fall into the categories of other retail and other services probably house businesses such as new and used auto dealers, health and personal care businesses, hardware, other building materials, and lawn and garden care stores. Also, they are quite likely to house financial and insurance businesses, other professional business services (i.e., lawyers), rental services, arts, and entertainment.

The mall sub-markets

The International Council of Shopping Centers (ICSC) divides shopping centers into a number of sub-sectors. *Neighborhood malls* are anchored by grocery or drug stores that are supported by the other tenants and that are conveniently located to serve residential customers. A supermarket or a discount store often anchors *community center malls* accompanied by home furnishings and electronic stores. They typically have a broader range of goods including soft goods and draw from a wider area. *Regional* and *super-regional* malls are typically enclosed with perimeter parking. They have major anchor tenants with a full range of general merchandise and services. *Super-regional malls* have more anchor tenants, more merchandise, and draw from a larger market shed than regional malls.

The ICSC identifies four additional types of centers: *fashion centers* with stores selling high-end fashions to high-end customers; *power centers* dominated by large department, off-price, and warehouse stores typically in stand-alone buildings that have few small stores; *theme/festival centers* that are often revitalized buildings in urban areas with a common theme and a restaurant or entertainment anchor; and *outlet centers* that are located in rural areas with manufacturer outlet stores. In terms of our initial three categories, outlet malls are likely to be “strip malls” while fashion centers, power centers, and theme centers fall into our category of standalone or multi-use buildings.

Table 24 displays median square footage and average sales for different categories of stores by type of mall. Generally, all types of stores are found in all types of malls. Certain types of retail operations have a much larger presence in some types of malls than others. Gray-shaded cells indicate the largest median square footage area for the type of store. Large general merchandise stores tend to be found in super regional malls and that grocery stores tend to be found in community and neighborhood malls. The large cloth-

ing stores tend to be found in community, regional, and super regional malls. Large shoe and home furnishings stores tend to be found in community malls. Food and liquor stores are found in community and neighborhood malls. Gift and jewelry stores do not vary much in size by the type of mall.

A similar type of comparison can be made by sales per square foot. The super-regional and regional malls, with their large marketing shed, tend to dominate sales for most types of retail operations (cells with bold numbers). The exceptions are food and drug retail operations where the sales per square foot are relatively constant across the mall types. Automotive sales tend to be regional.

Table 24 Median square footage and annual sales per square foot by type of retail operation and type of mall

	Super-regional		Regional		Community		Neighborhood	
	Median Sales per square foot (dollars)	Median Sales per square foot (dollars)	Median Sales per square foot (dollars)	Median Sales per square foot (dollars)	Median Sales per square foot (dollars)	Median Sales per square foot (dollars)	Median Sales per square foot (dollars)	Median Sales per square foot (dollars)
General merchandise	82,025	155	59,252	144	30,142	133	8,700	100
Automotive	8,340	140	4,400	184	5,654	146	4,532	136
Clothing and accessories	3,120	229	3,000	209	3,091	167	1,651	201
Building materials/hardware	n/a	n/a	8,508	178	4,340	131	4,886	111
Hobby/special interest	2,555	274	3,000	234	2,287	156	1,841	163
Drugs	7,993	229	10,102	228	11,153	247	9,176	241
Other retail	1,220	371	1,207	288	1,800	172	1,500	143
Shoes	2,035	291	2,421	241	3,000	168	2,042	145
Home furnishings	2,593	257	2,605	234	4,982	158	3,390	160
Food	1,008	340	1,090	303	27,715	310	26,176	312
Food service	746	406	935	289	1,810	229	1,733	183
Liquor	n/a	n/a	n/a	n/a	2,648	250	2,800	217
Home appliances/music	2,451	312	2,473	282	2,400	189	2,125	175
Gifts/specialty	2,464	267	2,500	197	2,673	146	2,250	149
Jewelry	1,129	748	1,078	549	1,263	264	1,006	280

Source: International Council of Shopping Centers, National research Bureau Shopping Center Database and Statistical Model, 2003 as adapted by Innovologie, LLC.

According to the ICSC, there were approximately 48,400 malls in the United States in 2003 (Table 25). The gross leasable area reported by ICSC is greater than that for the area of malls and strip malls reported by EIA, but some of what the ICSC considers to be malls, fashion centers, power centers, and theme/festival centers, likely falls into the EIA category of “other retail”.

Table 25 Number and percent of malls, leasable area, and annual sales by size category

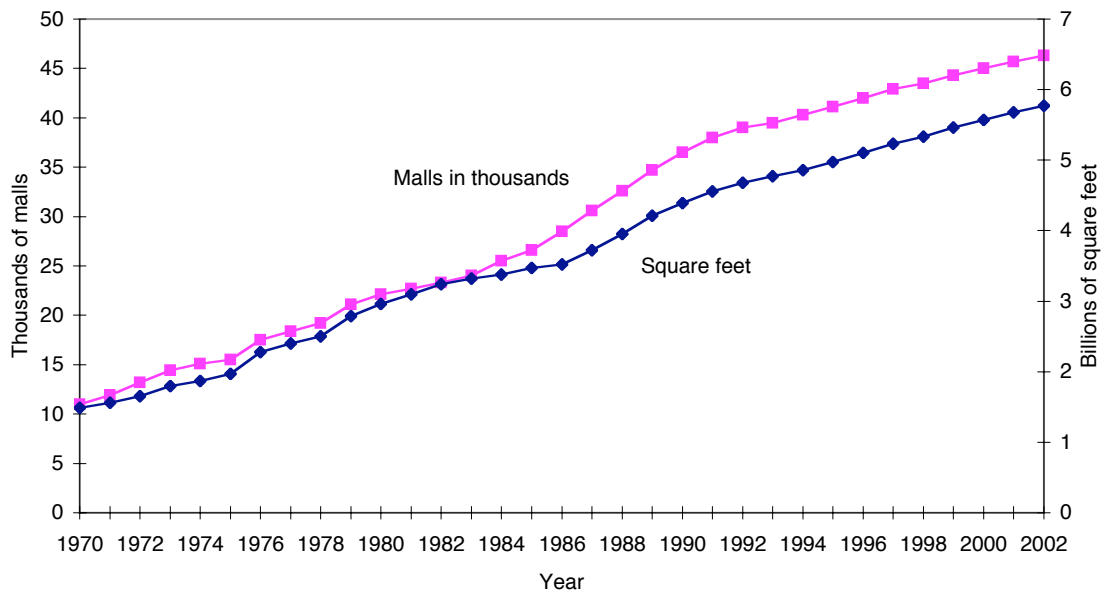
Size category in square feet	Number	Percent of malls	Total gross leasable area in millions	Percent gross leasable area	Total annual sales in millions	Percent of gross annual sales	Average dollars per square foot
Less than 100,001	28,819	62	1,424	25	\$370,564	29	\$260.16
100,001 to 200,000	11,220	24	1,552	27	\$324,369	25	\$209.04
200,001 to 400,000	4,137	9	1,120	19	\$195,307	15	\$174.54
400,001 to 800,000	1,507	3	836	14	\$165,127	13	\$197.60
800,001 to 1,000,000	332	1	299	5	\$81,273	6	\$271.75
More than 1,000,000	424	1	544	9	\$140,570	11	\$258.18
Total	46,439	100	5,774	99	\$1,277,210	99	\$221.19

Source: International Council of Shopping Centers, National Research Bureau Shopping Center Database and Statistical Model, 2003, as modified by Innovologie, LLC.

Eighty-six percent of the malls are less than 200,000 square feet. However, these malls account for just slightly more than half of the leasable gross area and half of annual sales in the mall category. Malls with more than 200,000 square feet account for almost half of the leasable square feet and half of annual sales.

Figure 46 shows the growth trends for the number of malls and gross leasable square feet. In general, both curves have a fairly constant slope although both have a flatter slope in the early 1980s and then a steeper slope between 1984 and 1991. The growth in the number of malls and square feet was less rapid in the early 1980s and more rapid in the late 1980s. Although it is hard to detect this in the graph, the size of the malls constructed in the late 1980s declined slightly as the number of malls increased. This reflects the rapid increase in strips malls during that period.

Figure 47 shows the trends in leasable square feet and annual sales. These data suggest that annual sales have increased more rapidly than have leasable square feet.



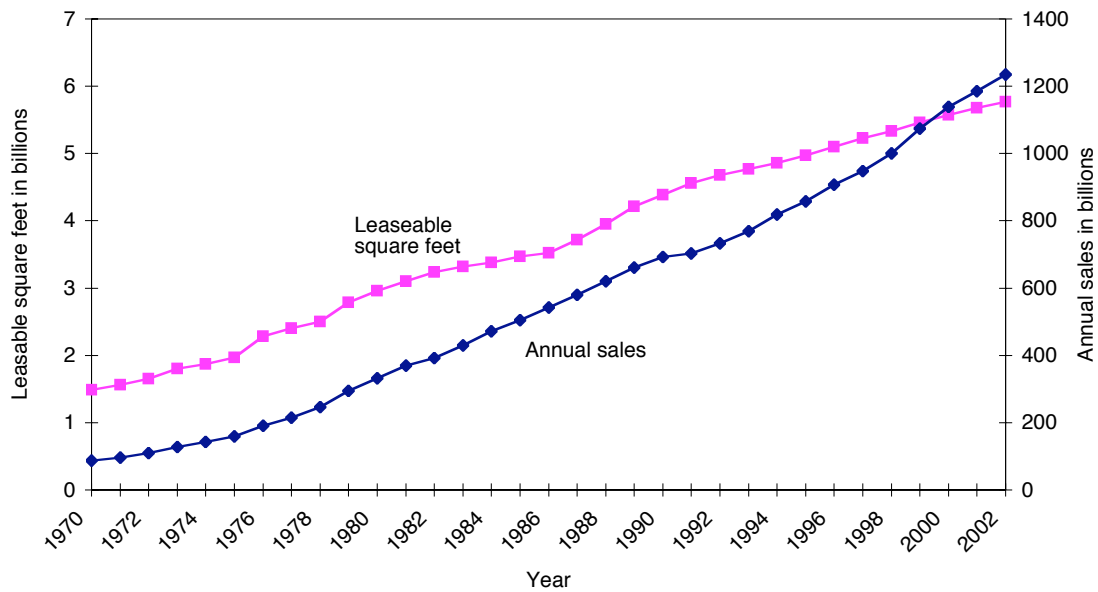
Source: International Council of Shopping Centers, National Research Bureau Shopping Center Database and Statistical Model, 2003, as presented by Innovologie, LLC.

Figure 46 Growth in the number of malls and gross leasable square feet

Mall redevelopment

A recent study by Price Waterhouse Coopers for the Congress for the New Urbanism suggests that within the next five years there may be as many as 300 to 400 regional malls nationwide that are economically obsolete and in need of redevelopment.¹¹³ Currently, these “Greyfield Malls” are about seven percent of the regional mall population, which is currently estimated at between 1,689 and 2,076 malls. Within the five-year period, Greyfield Malls may represent slightly less than 20 percent of the total population.

¹¹³ Price, Waterhouse Coopers, Greyfield Regional Mall Study, San Francisco: Congress for a New Urbanism, January 2001. www.cnu.org/cnu_reports/Executive_summary.pdf and www.cnu.org/cnu_reports/Greyfield_Feb_01.pdf. Lee S. Sobel, Ellen Greenberg and Steven Bodzin, Grey Fields into Goldfields. San Francisco: Congress for a New Urbanism, 2001.



Source: International Council of Shopping Centers, National Research Bureau Shopping Center Database and Statistical Model, 2003, as presented by Innovologie, LLC.

Figure 47 Trends in leasable square feet and annual sales

Greyfield Malls share a number of factors in common. The majority are privately owned. They have annual sales of less than \$150 per square with the average annual sales for the currently identified Greyfield Malls at \$114 per square foot. They have significantly lower occupancy rates than viable or healthy malls. They have gross leasable areas under a half million square feet. They are typically eight to ten years older than other malls and have been renovated much less recently than viable or healthy malls. They compete with an average of 22 retail centers within a five-mile radius representing an average of 2.33 million square feet of space.

The main concern with these malls is that they are no longer economically viable as malls and the buildings or sites require adaptive reuse. The alternative will be significant areas of blight in highly visible and/or important locations. The alternative to adaptive reuse of the buildings is to remove the buildings and use the land for other purposes. Potentially, these sites represent a significant opportunity to upgrade the efficiency of these buildings.

The top firms owning and managing retail properties

Just as we described for the commercial office sub-market, there is a fairly significant concentration of ownership in the retail sub-market. Table 26 shows the holdings in millions of square feet of the top 50 commercial retail owners, much of which is mall property. The largest holder of commercial retail floor space is the Simon Property Group with 183 million square feet. Combined, the top 50 firms own about 1.3 billion square feet, which relative to the total area of malls and strip malls, is 28 percent.

The space managed by firms is also shown in Table 26. The top 50 firms that manage retail space manage approximately 1.5 billion square feet. That is about 32 percent of the

floor space of mall and strip mall properties. Again, not all of this property is necessarily mall and strip mall property.

If one compares the owner and manager columns in Table 26, seventy percent or more of the largest owners manage nearly 100 percent of their own retail space. Approximately 10 of these top owners manage space in addition to their own, and five or six of them manage significantly more space than they own. There are about a half dozen of the 50 large owners who have others managing a significant proportion of their properties. Some of these are insurance companies and investment firms for whom property management is not part of their core business. These firms may use large national firms or may select smaller regional or local firms to manage their investment property. Finally, there are a number of firms that focus on managing retail properties for others and do not own enough property to be placed among the top 50 owners. There are about a dozen of these firms.

The bottom line is that about 70 percent of the large owners manage their own properties, about five or six percent manage large amounts of property in addition to the property they own, and about 20 percent of the top retail management firms mostly manage rather than own property.

It is also important to keep in mind that this is a dynamic industry and many players are acquiring or shedding space. Thus, these rankings are constantly changing.

Table 26 The top firms that own and/or manage retail properties.

Top owners/managers	City	State	Gross Lease area owned	Owner rank	Gross lease area managed	Management rank
Simon Property Group	Indianapolis	IN	183,394,000	1	181,508,000	1
General Growth Properties, Inc.	Chicago	IL	109,639,935	2	144,370,305	2
Kimco Realty Corp.	New Hyde Park	NY	74,633,371	3	86,177,000	3
Westfield America	Los Angeles	CA	63,500,000	4	62,800,000	5
The Macerich Company	Santa Monica	CA	57,900,000	5	55,400,000	7
New Plan Excel Realty Trust	New York	NY	52,000,000	6	55,000,000	8
The Rouse Co.	Columbia	MD	45,212,000	7	45,212,000	9
Benderson Development Co. Inc.	Buffalo	NY	40,000,000	8	40,000,000	11
Developers Diversified Realty	Beachwood	OH	39,722,102	9	No data	
Cafaro Co.	Youngstown	OH	33,883,000	10	33,883,000	14
CBL & Associates Properties	Chattanooga	TN	31,400,000	11	58,300,000	6
Lend Lease Real Estate Investments	Atlanta	GA	29,900,000	12	No data	

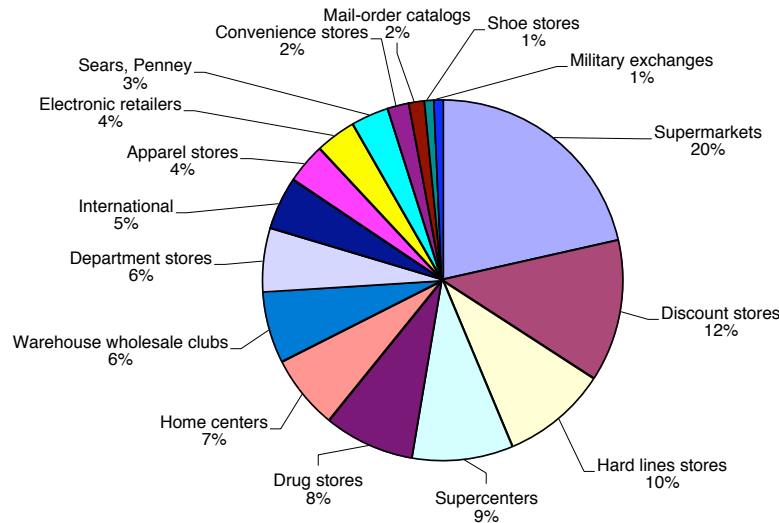
Top owners/managers	City	State	Gross Lease area owned	Owner rank	Gross lease area managed	Management rank
Weingarten Realty Investors	Houston	TX	29,772,000	13	29,772,000	15
Regency Centers	Jacksonville	FL	29,300,000	14	29,300,000	16
Heritage Property Investment Trust, Inc.	Boston	MA	25,924,762	15	25,924,762	18
Glimcher Realty Trust	Columbus	OH	25,700,000	16	25,700,000	19
Pan Pacific Retail Properties	Vista	CA	23,400,000	17	23,400,000	20
Taubman Centers, Inc.	Bloomfield Hills	MI	23,233,000	18	34,821,000	13
Edens & Avant	Columbia	SC	22,895,880	19	No data	
RD Management Corp.	New York	NY	22,000,000	20	23,400,000	21
Garden Commercial Properties	Short Hills	NJ	20,752,024	21	20,752,024	23
The Pyramid Cos.	Syracuse	NY	19,450,000	22	19,450,000	24
The Mills Corp.	Arlington	VA	19,000,000	23	19,000,000	26
Crown American Realty Trust	Johnstown	PA	17,000,000	24	17,000,000	27
Casto	Columbus	OH	16,940,488	25	16,940,488	28
THF Realty	St. Louis	MO	16,100,000	26	16,100,000	30
Federal Realty Investment Trust	Rockville	MD	15,200,000	27	No data	
Colonial Properties Trust	Birmingham	AL	14,900,000	28	14,900,000	32
Chelsea Property Group	Roseland	NJ	14,600,000	29	14,600,000	33
Wilmore Properties, Inc.	Rochester	NY	13,667,470	30	15,859,411	31
Prudential Real Estate Investors	Parispany	NJ	13,300,000	31	No data	
National Realty & Development Corp.	Purchase	NY	12,938,415	32	12,938,415	36
Vornado Realty Trust	Paramus	NJ	12,400,000	33	No data	
S.R. Weiner & Associates, Inc./Ws Development & Associates, LLC	Chestnut Hill	MA	12,069,350	34	12,960,170	35
Kravco Co.	King of Prussia	PA	12,000,000	35	No data	
Pennsylvania Real Estate Investment Trust	Philadelphia	PA	11,800,000	36	19,200,000	25
Kramont Realty Trust	Plymouth Meeting	PA	11,447,000	37	11,447,000	40
Aronov Realty Management	Montgomery	AL	11,300,000	38	11,300,000	41

Top owners/managers	City	State	Gross Lease area owned	Owner rank	Gross lease area managed	Management rank
Fletcher Bright Co.	Chattanooga	TN	11,200,425	39	12,410,500	38
Inland Real Estate Corp.	Oak Brook	IL	11,094,340	40	11,094,340	43
Vestar	Phoenix	AZ	10,550,000	41	12,300,000	39
Ramco-Gershenson Properties Trust	Southfield	MI	10,005,502	42	13,470,488	34
J.J. Gumberg Co.	Pittsburgh	PA	9,750,000	43	11,250,000	42
Equity One, Inc	Miami Beach	FL	8,800,000	44	No data	
Hull Storey Retail Group	Augusta	GA	8,202,691	45	No data	
Breslin Realty Development Corp.	Garden City	NY	8,000,000	46	No data	
Prime Retail, Inc.	Baltimore	MD	7,300,000	47	10,500,000	45
Glimcher Group	Pittsburgh	PA	7,100,500	48	No data	
DLC Management Corp.	Tarrytown	NY	7,084,358	49	No data	
Schostak Brothers & Co.	Southfield	MI	7,000,000	50	No data	
CB Richard Ellis	Los Angeles	CA	No data		65,000,000	4
Trammell Crow Co.	Dallas	TX	No data		41,400,000	10
Urban Retail Properties Co.	Chicago	IL	No data		40,000,000	12
Jones Lang Lasalle			No data		28,200,000	17
Madison Marquette	Washington	DC	No data		21,530,356	22
Mid-America Asset Management, Inc.	Oakbrook Terrace	IL	No data		16,900,000	29
Donahue Schriber	Costa Mesa	CA	No data		12,689,976	37
Divaris Real Estate, Inc.	Virginia Beach	VA	No data		11,027,817	44
Insignia/ESG, Inc.	New York	NY	No data		10,330,000	46
Levin Management Corp.	Plainfield	NJ	No data		10,132,598	47
Edgemark Commercial Real Estate Services LLC	Oakbrook	IL	No data		9,665,271	48
Belz Enterprises	Memphis	TN	No data		9,170,689	49
Finard & Company, LLC	Burlington	MA	No data		9,100,000	50
Total			1,334,362,613		1,533,587,610	

Source: Shopping Center World, data as of December 31, 2002. http://shoppingcenterworld.com/ar/retail_top_managers_3/index.htm and http://shoppingcenterworld.com/ar/retail_top_owners_2/index.htm. A number of the cells in the table are marked with the notation, "No data," that indicates that data was not available for these firms because they do not own or manage sufficient property to be listed among the top 50 owners or managers. These firms may own or manage substantial amounts of property but they are not among the larger firms who own or manage property.

The top retailers

In the previous section, we examined the owners and managers of leased property. Many of the top retailers are the clients of these large owners and property managers. The top 100 retailers have revenues of approximately \$1.2 trillion or 34 percent of the total of \$3.4 trillion in annual retail revenue. Figure 48 shows how the revenues distribute across different categories of retail. Supermarkets, discount stores, hard line stores, and super



Source: Chain Store Age, August, 2002, www.chainstoreage.com

Figure 48 Breakout of revenues by category for the top 100 retailers

centers account for about half of all annual retail revenues.

Table 27 shows the top 100 retailers in the U.S. in 2001 in terms of their gross revenues and number of stores.

Wal-Mart is clearly the largest retailer accounting for \$219 billion in sales or slightly more than one-sixth of the total. The next largest retailer is Home Depot with \$54 billion. The top 10 retailers include three grocery stores, a home center, three super-center discount stores, two department stores, and a wholesale club. Because the operations of these retailers span multiple categories, it is difficult to discreetly place them in one or another of the categories.

Some of these retailers own their own space, some lease space, and some own and lease space. At the present time, we cannot separate retailers into these categories. The important point is that 100 firms control 25,000 retail spaces and significant amounts of space. Whether they own or lease they have a great deal of control over the physical characteristics of the space including how energy is used in that space. If they own the space, they make decisions affecting energy directly. If they have what essentially amounts to a ground lease, they make decisions affecting energy use directly. If they lease in a build to suit arrangement, they may still influence energy use decisions.

Table 27 Gross sales and number of stores for the top 100 retailers in 2001

2001 Rank	Firm Name	Gross revenues in (000s)	Number of stores	Headquarters Location	Retail Category(ies)	Date of Data
1	Wal-Mart Stores Inc.	\$219,812,000	4,414	Bentonville, AR	Super Center	1/31/02
2	The Home Depot	\$53,553,000	1,333	Atlanta, GA	Home Center	2/3/02
3	The Kroger Co.	\$50,098,000	3,634	Cincinnati, OH	Supermarket	2/2/02
4	Sears, Roebuck and Co.	\$41,078,000	2,185	Hoffman Estates, IL	Department Store Hard Line Specialty Catalog Home Center Electronic	12/29/01
5	Target Corp.	\$39,888,000	1,381	Minneapolis, MN	Discount Department Store Super Center Electronics	2/2/02
6	Albertson's	\$37,931,000	2,421	Boise, ID	Supermarket Drug	1/31/02
7	Kmart Corp.	\$36,151,000	2,114	Troy, MI	Discount Super Center Electronics	1/30/02
8	Costco	\$34,797,037	369	Issaquah, WA	Warehouse Wholesale Club Catalog Electronics	9/2/01
9	Safeway	\$34,301,000	1,773	Pleasanton, CA	Supermarket	12/29/01
10	J.C. Penney	\$32,004,000	3,770	Plano, TX	Department Store Catalog Drug Store Electronics	1/26/02
11	Dell Computer	\$31,168,000	DNA	Round Rock, TX	Catalog Electronics	2/1/02
12	Walgreen Co.	\$24,623,000	3,520	Deerfield, IL	Drug Store	8/31/01
13	Ahold USA**	\$23,212,000	1,430	Chantilly, VA	Supermarket	12/30/01

2001 Rank	Firm Name	Gross revenues in (000s)	Number of stores	Headquarters Location	Retail Category(ies)	Date of Data
14	CVS Corp.	\$22,241,400	4,191	Woonsocket, RI	Electronics Drug Store Electronics	12/29/01
15	Lowe's Cos.	\$22,111,108	744	Wilkesboro, NC	Home Center Electronics	2/1/02
16	Best Buy	\$19,597,000	1,896	Eden Prairie, MN	Catalog Electronics	3/2/02
17	Federated Department Stores	\$15,651,000	459	Cincinnati, OH	Department Store Catalog Electronics	2/2/02
18	Publix Super Markets	\$15,370,019	684	Lakeland, FL	Supermarket	12/29/01
19	Rite Aid	\$15,171,146	3,497	Camp Hill, PA	Drug Store	3/2/02
20	Delhaize America	\$14,900,000	1,459	Salisbury, NC	Supermarket	12/31/01
21	May Department Stores	\$14,215,000	839	St. Louis, MO	Department Store Apparel Specialty	2/2/02
22	Gap Inc.	\$13,847,873	3,097	San Francisco, CA	Apparel Specialty Electronics	2/2/02
23	Winn-Dixie	\$12,903,373	1,153	Jacksonville, FL	Supermarket	6/27/01
24	Meijer	\$11,923,000	155	Grand Rapids, MI	Super Center	12/31/01
25	Office Depot	\$11,200,000	1,002	Delray Beach, FL	Hard Line Specialty Electronics	12/29/01
26	Toys "R" Us	\$11,019,000	1,599	Paramus, NJ	Hard Line Specialty Apparel Specialty Electronics	2/2/02
27	A&P	\$10,973,315	702	Montvale, NJ	Supermarket	2/23/02
28	Staples	\$10,744,373	1,436	Framingham, MA	Hard Line Specialty Electronics	2/2/02
29	TJX Cos.+	\$10,708,998	1,665	Framingham, MA	Apparel Specialty Hard Line	1/26/02

2001 Rank	Firm Name	Gross revenues in (000s)	Number of stores	Headquarters Location	Retail Category(ies)	Date of Data
30	7-Eleven	\$9,894,100	5,829	Dallas	Specialty Convenience Store	12/31/01
31	Circuit City Stores**+	\$9,589,803	624	Richmond, VA	Hard Line Specialty Electronics	2/28/02
32	SuperValu**	\$9,549,068	1,260	Minneapolis, MN	Supermarket	2/23/02
33	The Limited Inc.+	\$9,363,000	4,614	Columbus, OH	Apparel Specialty Catalog Electronics Hard Line Specialty	2/2/02
34	H.E. Butt Grocery Co.	\$9,000,000	300	San Antonio, TX	Supermarket	10/28/01
35	Circle K	\$8,866,440	3,933	Tempe, AZ	Convenience Store	12/31/01
36	Dillard's	\$8,154,911	338	Little Rock, AR	Department Store	2/2/02
37	Kohl's Department Stores	\$7,488,654	382	Menomonee Falls, WI	Department Store	2/2/02
38	Army & Air Force Exchange	\$7,132,000	162	Dallas, TX	General Merchandise	2/1/02
39	Gateway	\$6,079,524	277	North Sioux City, SD	Electronics Hard Line Specialty	12/31/01
40	Saks Inc.	\$6,070,568	356	Birmingham, AL	Department Store Electronics	2/2/02
41	Nordstrom	\$5,634,130	156	Seattle, WA	Department Store Apparel Specialty Catalog Electronics	1/31/02
42	Dollar General	\$5,322,895	5,540	Goodlettsville, TN	Discount	2/1/02
43	BJ's Wholesale Club	\$5,279,730	130	Natick, MA	Warehouse Wholesale Club	2/3/02
44	Menard	\$5,200,000	160	Eau Claire, WI	Home Center	12/31/01

2001 Rank	Firm Name	Gross revenues in (000s)	Number of stores	Headquarters Location	Retail Category(ies)	Date of Data
45	Blockbuster	\$5,156,700	7,981	Dallas, TX	Hard Line Specialty	12/31/01
46	Barnes & Noble	\$4,870,390	1,934	New York, NY	Hard Line Specialty Electronics	2/2/02
47	AutoZone	\$4,818,185	3,040	Memphis, TN	Hard Line Specialty	8/25/01
48	Radio Shack	\$4,775,700	7,246	Fort Worth, TX	Hard Line Specialty Electronics	12/31/01
49	OfficeMax	\$4,636,024	993	Shaker Heights, OH	Hard Line Specialty Electronics	1/26/02
50	Shaw's Supermarkets**	\$4,400,000	185	East Bridgewater, MA	Supermarket	3/30/02
51	Foot Locker+	\$4,379,000	3,590	New York, NY	Shoe Store Apparel Specialty Hard Line Specialty Catalog Electronics	2/2/02
52	Giant Eagle	\$4,336,000	201	Pittsburgh, PA	Supermarket	6/30/02
53	Longs Drug Stores	\$4,304,734	436	Walnut Creek, CA	Drug	1/31/02
54	CompUSA	\$4,152,450	226	Dallas, TX	Hard Line Specialty Electronics	12/31/01
55	Pathmark Stores	\$3,963,300	141	Carteret, NJ	Supermarket	2/2/02
56	CDW Computer Centers	\$3,961,545	2	Vernon Hills, IL	Catalog Electronics	12/31/01
57	QVC**	\$3,917,300	8	West Chester, PA	Electronics	12/31/01
58	Hy-Vee	\$3,800,000	215	West Des Moines, IA	Supermarket	9/30/01
59	Family Dollar Stores	\$3,665,362	4,141	Matthews, NC	Discount	9/1/01
60	Big Lots Inc.+	\$3,433,321	1,335	Columbus, OH	Discount Electronics	2/2/02

2001 Rank	Firm Name	Gross revenues in (000s)	Number of stores	Headquarters Location	Retail Category(ies)	Date of Data
61	Borders Group	\$3,387,900	1,190	Ann Arbor, MI	Hard Line Specialty Electronics	2/27/02
62	ShopKo Stores Inc.	\$3,386,989	366	Green Bay, WI	Discount	2/2/02
63	Raley's	\$3,300,000	149	West Sacramento, CA	Supermarket	6/30/02
64	Ames Department Stores	\$3,291,800	333	Rocky Hill, CT	Discount	2/2/02
65	Sherwin Williams**	\$3,185,000		Cleveland, OH	Hard Line Specialty	12/31/01
66	Amazon.com	\$3,122,433	DNA	Seattle, WA	Hard Line Specialty electronics	12/31/01
67	Spiegel	\$3,079,000	607	Downers Grove, IL	Catalog Apparel Specialty Electronics	12/29/01
68	Neiman Marcus Group	\$3,015,500	48	Chestnut Hills, MA	Department Store Catalog Hard Line Specialty	7/28/01
69	Ross Stores	\$2,986,596	452	Newark, CA	Apparel Specialty Electronics	2/2/02
70	Bed Bath & Beyond	\$2,927,962	396	Union, NJ	Hard Line Specialty Electronics	3/2/02
71	Aldi	\$2,917,200	596	Batavia, IL	Supermarket	12/31/01
72	Payless Shoe Source	\$2,913,700	4,964	Topeka, KS	Shoe Store	2/2/02
73	Wegmans Food Markets	\$2,900,000	62	Rochester, NY	Supermarket	12/31/01
74	MicroWarehouse Inc.*	\$2,600,000		Norwalk, CT	Catalog Electronics	12/31/01
75	Burlington Coat Factory Warehouse Corp.	\$2,577,000	319	Burlington, NJ	Apparel Specialty Hard Line Specialty	6/1/02
76	Stater Bros. Markets	\$2,573,900	155	Colton, CA	Supermarket Electronics	9/30/01
77	Michaels Stores	\$2,530,727	835	Irving, TX	Hard Line	2/2/02

2001 Rank	Firm Name	Gross revenues in (000s)	Number of stores	Headquarters Location	Retail Category(ies)	Date of Data
					Specialty	
78	Advance Auto Parts	\$2,517,639	2,484	Roanoke, VA	Hard Line Specialty	12/29/01
79	Pet Smart	\$2,501,012	560	Phoenix, AZ	Hard Line Specialty Electronics	2/3/02
80	Footstar	\$2,460,500	7,400	Mahwah, NJ	Shoe Store	12/29/01
81	Harris-Teeter**	\$2,416,799	137	Matthews, NC	Supermarket	9/30/01
82	Penn Traffic	\$2,404,302	218	Syracuse, NY	Supermarket	2/2/02
83	Fleming Cos.**	\$2,361,000	116	Oklahoma City, OK	Supermarket	
84	Value City	\$2,283,878	246	Columbus, OH	Discount Shoe Store Apparel Specialty	2/2/02
85	Whole Foods Market	\$2,272,231	126	Austin, TX	Supermarket	9/30/01
86	Speedway Super America LLC***	\$2,253,000	2,104	Enon, OH	Convenience Store	12/31/01
87	Belk	\$2,243,151	207	Charlotte, NC	Department Store Electronics	2/2/02
88	The Pep Boys	\$2,183,715	628	Philadelphia, PA	Hard Line Specialty	2/2/02
89	Williams-Sonoma	\$2,096,000	415	San Francisco, CA	Catalog Hard Line Specialty Electronics	2/3/02
90	Zale	\$2,068,242	2,344	Dallas, TX	Hard Line Specialty	7/31/01
91	Medicine Shoppe International	\$2,041,000	1,336	St. Louis, MO	Drug Store	6/30/01
92	Price Chopper/Golub Corp.	\$2,001,000	114	Schenectady, NY	Super Market	4/30/02
93	Schnuck Markets	\$2,000,000	91	St. Louis, MO	Super Market	10/31/01
94	Berkshire Hathaway**	\$1,998,000	329	Omaha, NE	Hard Line Specialty	12/31/01
95	Charming Shoppes	\$1,993,843	2,446	Philadelphia, PA	Apparel Specialty Catalog	2/2/02
96	Weis Markets	\$1,988,246	196	Sunbury, PA	Super Market	12/29/01

2001 Rank	Firm Name	Gross revenues in (000s)	Number of stores	Headquarters Location	Retail Category(ies)	Date of Data
97	Dollar Tree	\$1,987,321	1,975	Chesapeake, VA	Hard Line Specialty Discount	12/31/01
98	Navy Exchange Service Command	\$1,982,337	111	Virginia Beach, VA	General Merchandise	2/2/02
99	Ingles Markets	\$1,953,440	203	Asheville, NC	Supermarket	9/27/01
100	Smart & Final	\$1,946,723	224	City of Commerce, CA	Supermarket Warehouse Wholesale Club	12/30/01
Total		\$1,173,036,562	25,319			

Source: Chain Store Age, August 2002 as modified by Innovologie, LLC. * estimate ** retail operations only, operating income reported ***excludes fuel sales + continuing operations

Trends in retail construction

An assessment by the Urban Land Institute (ULI) suggests that the retail market has suffered serious setbacks in the past few years that signal fundamental changes in the ways that customers shop. ULI believes that retail construction will continue to decline in the short-term due to slowing growth in retail sales, an abundance of retail space, and cautious lenders and investors.¹¹⁴ However, the demand for new retail space in selected consumer target markets, specifically grocery stores and discount stores, will grow. Construction of neighborhood shopping centers is expected to remain strong. Traditional retailers and chain stores face steady declines that may lead to a downturn in these types of retail establishments.

Many retailers are looking to expand, but in a very selective way and combined with closings of less profitable stores. They are giving more serious consideration to location choices because of cannibalization of their other stores. (David Robert Nelson of the Nelson Companies in West Bloomfield, Michigan)

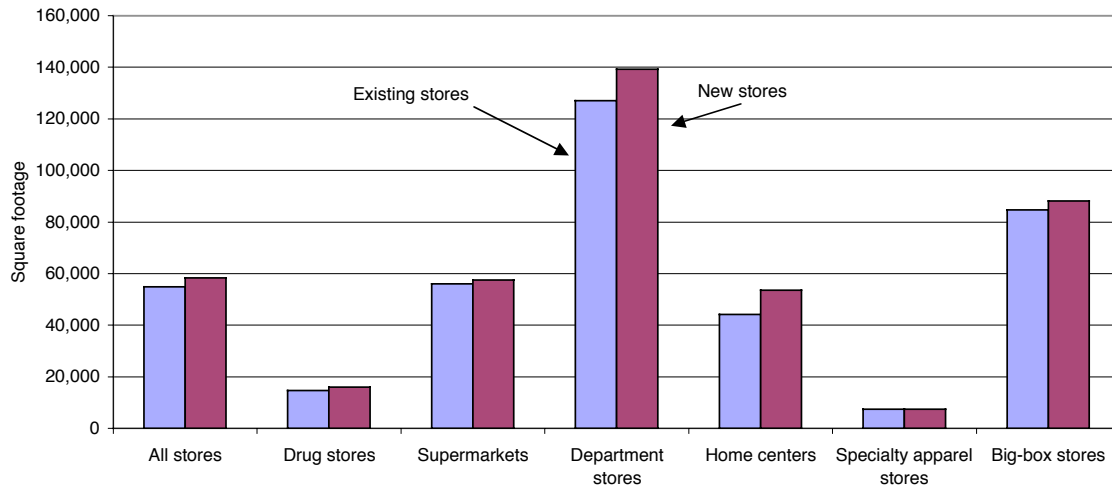
Among chain stores, same-store sales fell by 11 percent in February 2001 compared to a year earlier. For example, The Gap had been extremely aggressive during recent years, increasing the number of stores by 22 percent in fiscal year 2000. Now, it plans to take a slightly more conservative approach with 17 to 20 percent growth in stores for 2001 and then 15 percent growth for 2002 and 2003.¹¹⁵

¹¹⁴ Urban Land Institute Forecast

¹¹⁵ Therese Byrne, "Malls Half-Baked: In Search of Alternative Realities and Capital," *Reis Insights -- Commentary and Analysis*, REIS August 6, 2002.

The physical characteristics of retail construction

Our research indicates that some types of buildings in the retail market are increasing in size (Figure 49)¹¹⁶. This shift toward larger spaces is most apparent in the department store sub-sector where the average square footage of stores has increased from about 123,000 square feet in existing (older) buildings to 140,000 square feet in new stores. In the specialty apparel sub-sector store size remains constant at about 20,000 square feet. Increased size is likely to mean increased energy usage and perhaps an interest on the part of owners and occupants in controlling the usage more carefully.

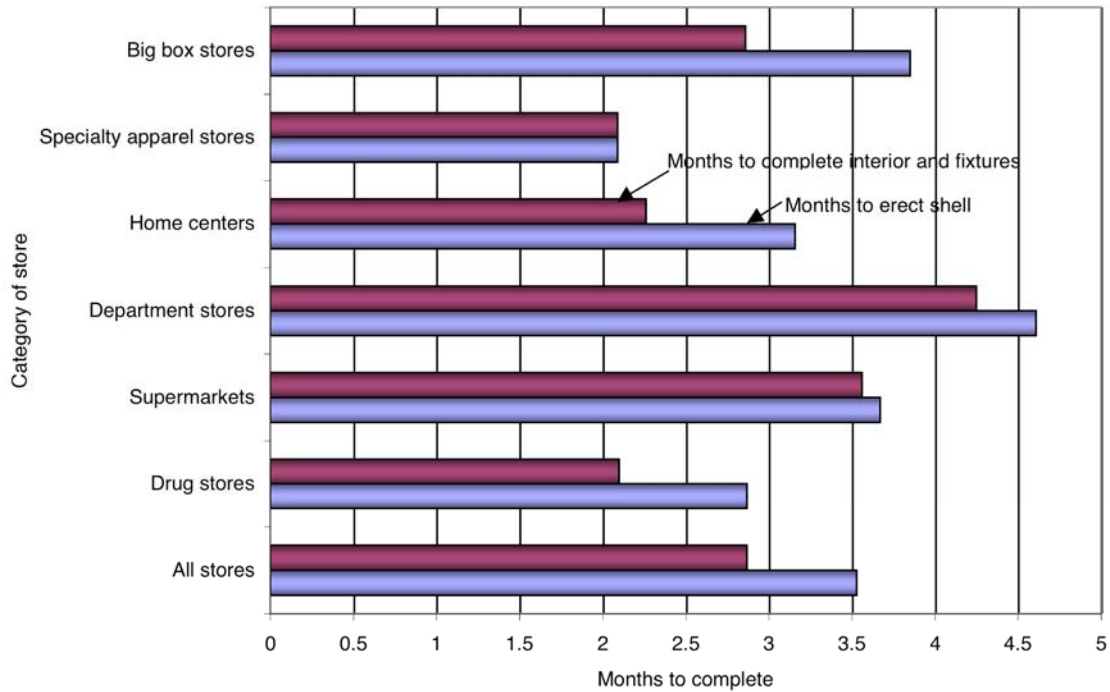


Source: Chain Store Age/Leo J. Shapiro, "Building Big," *Chain Store Age Magazine*, July 2001, p. 92.

Figure 49 Comparison of average square footage between existing and new retail stores

It takes just about six months to construct most types of retail stores (Figure 50). The shell of the average building takes about 3.5 months and the interior 11 weeks. There is some variation by type of store. Department stores and supermarkets typically take longer than other types of stores. Size and complexity of the operation in the space appear to be factors in the amount of time it takes to construct a building.

¹¹⁶ Chain Store Age/Leo J. Shapiro, "Building Big," *Chain Store Age Magazine*, July 2001, p. 92.

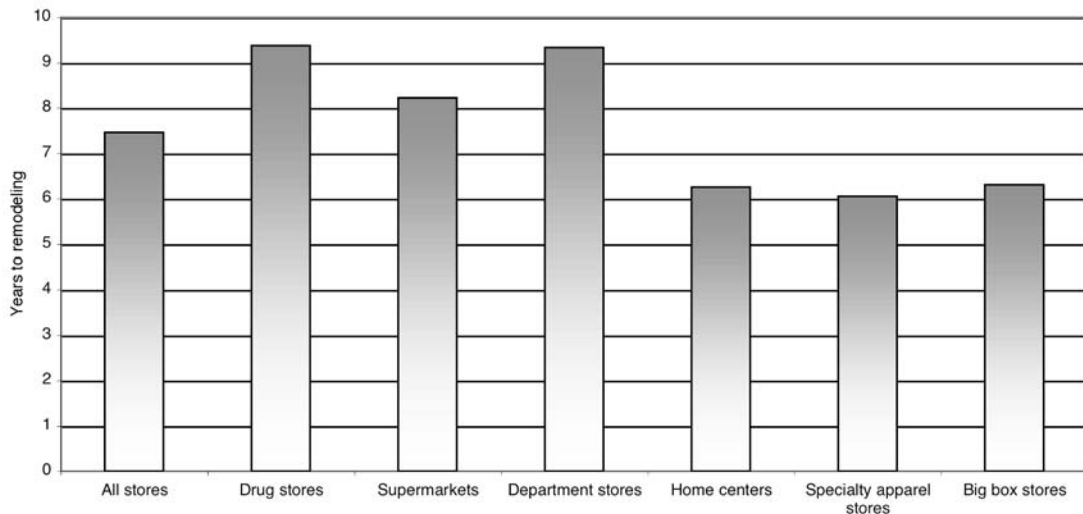


Source: Chain Store Age/Leo J. Shapiro, "Building Big," *Chain Store Age Magazine*, July 2001, p. 92.

Figure 50 Timeline to complete new construction in the retail sub-market

The rapidity with which construction is completed has implications for implementing energy efficiency. Lead times required for ordering materials are weeks and even months in advance of actual construction. With a six-month construction timeline, decisions about materials are mostly made before construction starts. Thus, once construction has started, it is too late to incorporate energy efficiency in a holistic way into designs. Site acquisition and planning typically precede construction by months. Retail space acquisition typically involves negotiating with the owner of lease space about the improvements that will be made and who is responsible for them. Thus, many decisions are foreclosed at the acquisition phase.

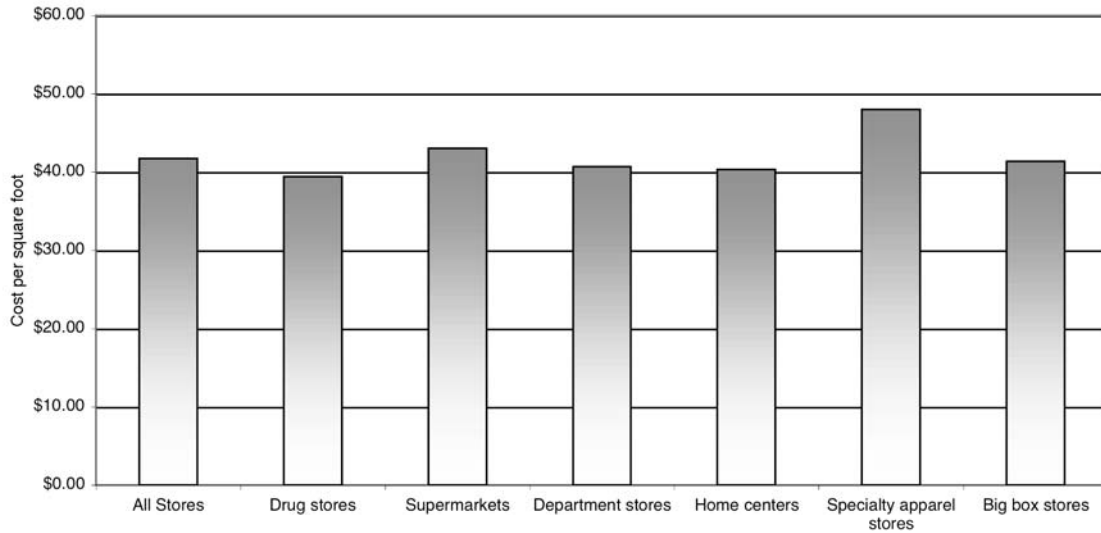
The average store is remodeled between seven and eight years (Figure 51). Home centers, specialty apparel, and big box stores have a six-year cycle, while department stores, supermarkets, and drug stores are on eight to nine-year cycles. The cycle time is probably driven by several factors. One factor is likely to be the investment involved. Supermarkets and department stores probably involve greater capital investments. A second factor is the “life-time of the look.” Big box and apparel stores may need to freshen their look more often than supermarkets and department stores. The important point is that one does not have to wait through the lifetime of a retail building to change its energy use characteristics. There are opportunities to change the building when the building is remodeled and when there is tenant turnover. The notion that the characteristics of a building are fixed for its lifetime is simply fallacious.



Source: Chain Store Age/Leo J. Shapiro, “Building Big,” *Chain Store Age Magazine*, July 2001, p. 92.

Figure 51 The average number of years before stores are remodeled by type

The cost of erecting a building shell in 2000 hovered around \$41 per square foot. Specialty apparel stores were the most costly at around \$48 per square foot. Supermarkets tend to cost around \$42 per square foot. The high cost of specialty apparel stores may be due to their need to differentiate themselves from the competition and the fact that costs are spread over a much smaller area than other types of stores. In contrast, most of the other stores spend an average of about \$40 per square foot on the building shell.



Source: Chain Store Age/Leo J. Shapiro, "Building Big," *Chain Store Age Magazine*, July 2001, p. 92.

Figure 52 The average cost per square foot to erect a building shell

Throwaway buildings

Two important points arise from the discussion with respect to remodeling and the earlier discussion of Greyfield Malls. We tend to think of buildings as being long-lived, especially the buildings at the urban core. But, it is not clear that this is the intention with respect to many buildings, especially retail buildings, which have been constructed in the last 30 years. At least some retail buildings are built on sites with ground leases. The owner of the site leases it for an extended period, generally 20 years. The lessee constructs a building for their use at the site. At the end of the lease, the terms of the lease are either renegotiated or the building reverts to the site owner. The building and the site may revert to the owner even sooner under some circumstances. The important point is that buildings are constructed with the assumption that their lifetime may be 20 years.

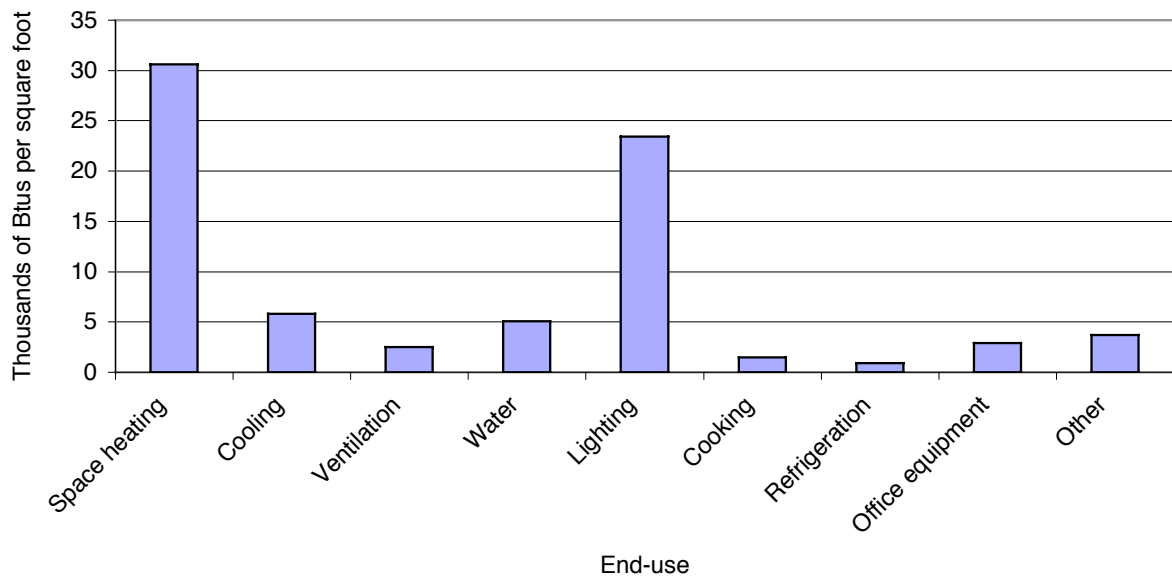
There is a somewhat similar pattern within malls and strip malls. The occupancy of malls and strip malls is dynamic with a constantly changing set of retailers. This leads to constant changes within the building. There are different reasons for these changes. Developers target their retail space to certain groups of people and recruit retailers with that in mind. Locations become more or less important as transportation networks change. Retailers develop brands and stores to serve different customer segments and/or are careful to choose locations to capture the customer segments they intend to serve.

These practices recognize the dynamics of the marketplace and the impact of the changing nature of neighborhoods, communities, and road networks on markets and retail spaces. In this view of the market, at least some building shells are carriers for image and branding. Shells are necessary but expendable.

Energy end-use intensities in retail buildings

The average annual energy intensity of a retail building is 76.2 thousand BTUs per square foot (Figure 53). Almost half of that usage is space heating. If space heating, cooling, and ventilation are combined, then space conditioning is more than half of the energy intensity. After space conditioning, lighting is the next most important accounting for about a third of energy use. Other uses are quite small.

It is important to keep in mind that these are national figures. Space cooling is undoubtedly more important in the South and West than in the North and Northeast. Another point to keep in mind is that some types of commercial and service spaces tend to have large volumes.



Source: DOE, EIA CBECS 1995, Energy Consumption and End-Use, Table EU-2.

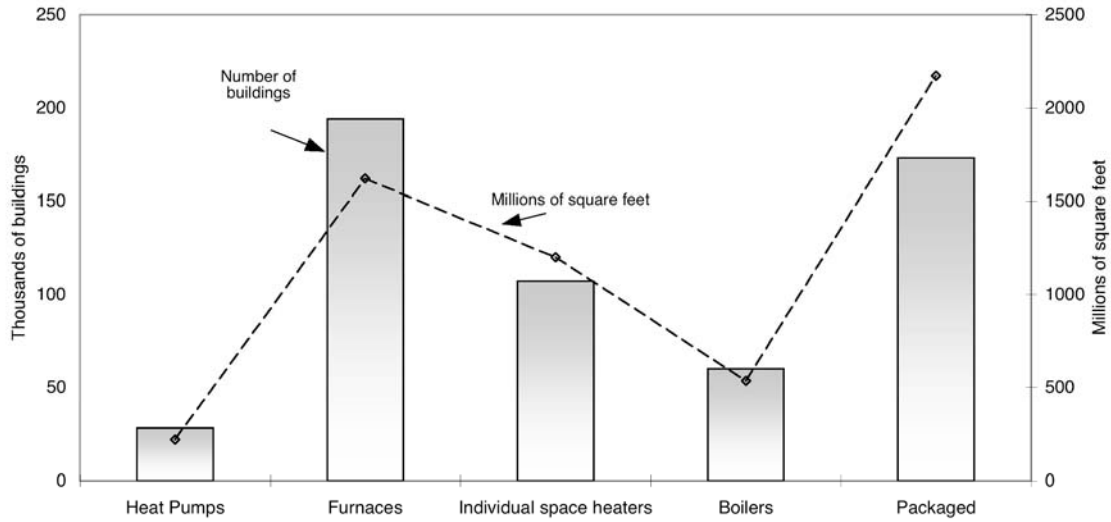
Figure 53 End-use intensities in the retail sector

Energy using technologies in the retail sub-market

Ninety-seven percent of all retail floor space and 93 percent of all mall floor space is heated.

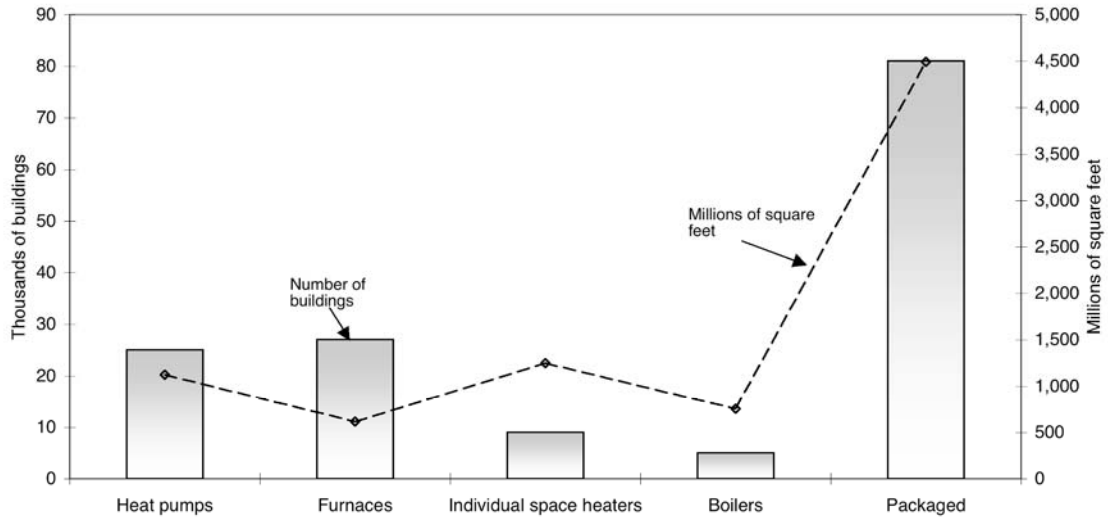
Figure 54 shows that furnaces are the most frequent type of heating unit but that packaged units are used to heat the most square feet. Packaged units tend to be used in enclosed malls and strip malls (Figure 55) while furnaces tend to be used in the older, small, other retail spaces.

In the United States, 93 percent of all retail buildings and nearly all enclosed and strip malls (99 percent) are air conditioned. Packaged units are the most commonly installed cooling equipment in both other retail space (53 percent) and malls (81 percent). Package units are found in buildings representing 66 percent of cooled floor space in other retail buildings and 90 percent of cooled floor space in shopping and strip malls.



Source: EIA, CBECS 1999 Tables B32-B33

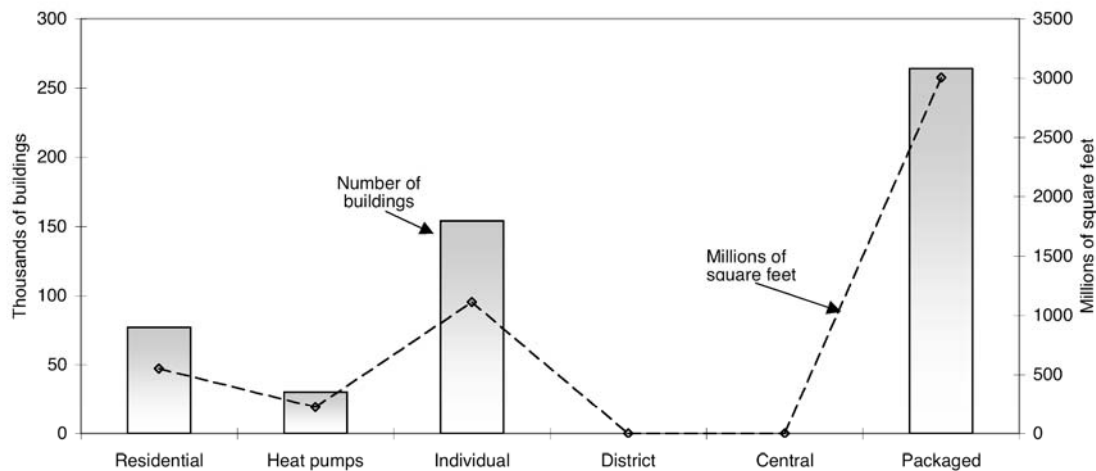
Figure 54 Heating equipment in other retail stores



Source: EIA, CBECS 1999 Tables B32-B33

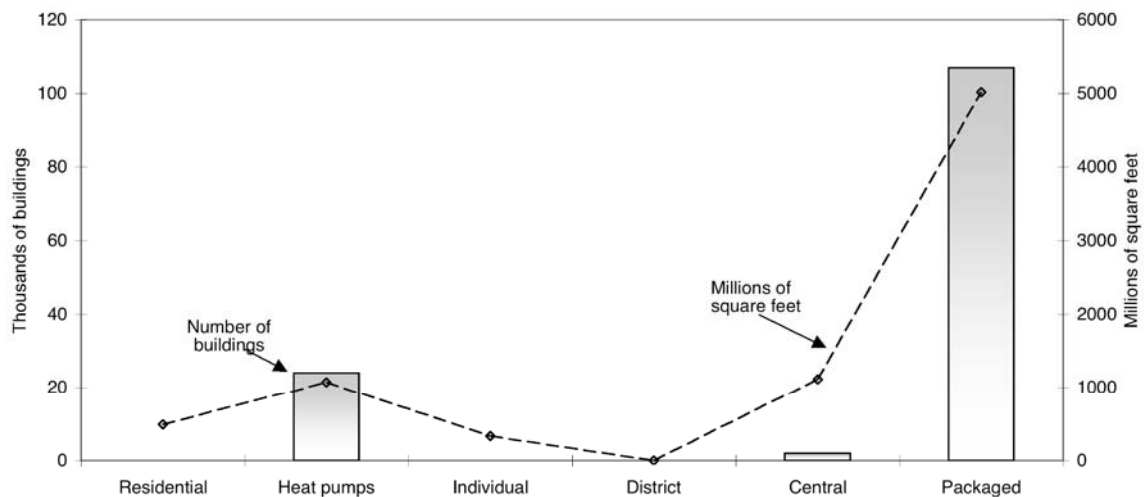
Figure 55 Heating equipment in enclosed and strip malls

Figure 56 and Figure 57 show that packaged units predominate in both malls and other retail spaces. However packaged units and heat pumps are almost exclusively used in malls while individual and residential type cooling technologies are found in many other retail buildings.



Source: EIA, CBECS 1999 Tables B34-B35

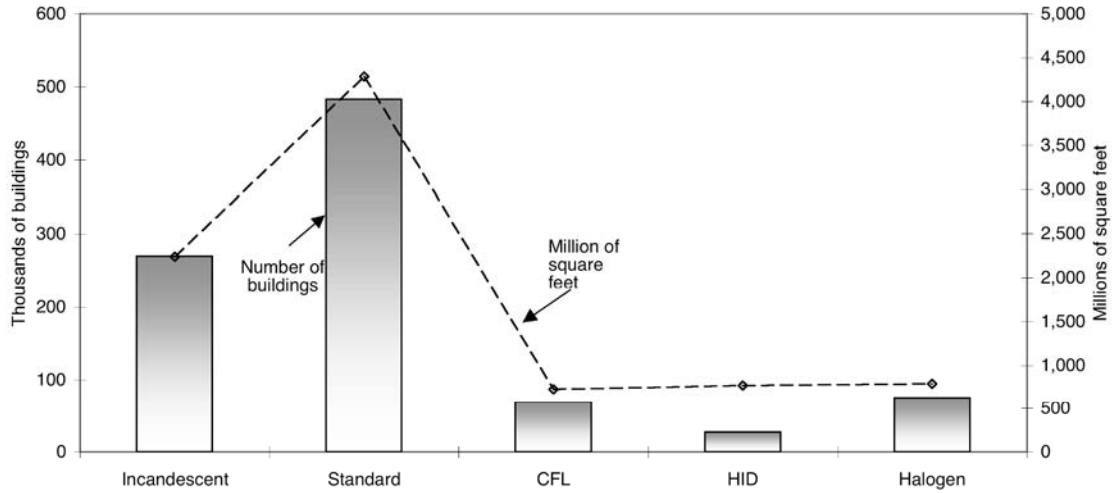
Figure 56 Air conditioning equipment in the retail stores sub-market



Source: EIA, CBECS 1999 Tables B34-B35

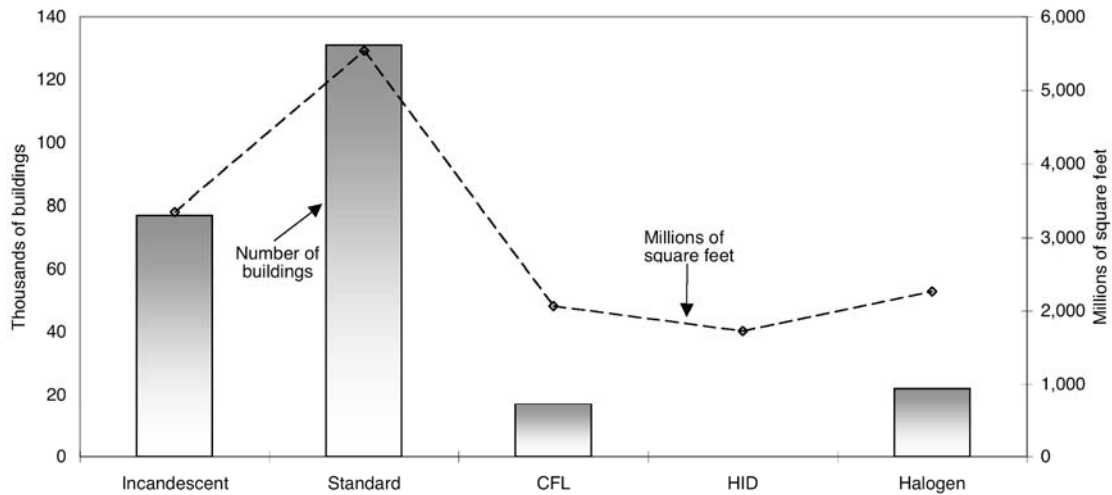
Figure 57 Air conditioning equipment in enclosed and strip malls

Standard fluorescent lighting is the most commonly installed type of lighting and is found in buildings representing more than 90 percent of all retail floor space and 98 percent of all mall floor space (Figure 58 and Figure 59). Compact fluorescent lamps (CFLs) are found in retail buildings representing 15 percent of floor space and 37 percent of floor space in the mall segment. High intensity discharge lamps (HIDs) are not widely used to light other retail floor space (buildings representing 16 percent of floor space), but are found in buildings representing nearly one-third (31 percent) of the floor space in malls. Halogen lighting fixtures account for approximately 17 percent and 40 percent of the lit floor space in other retail space and malls, respectively.



Source: EIA, CBECS 1999 Tables B38-B39

Figure 58 Lighting equipment installed in the other retail sub-market



Source: EIA, CBECS 1999 Tables B38-B39

Figure 59 Lighting in the enclosed and strip malls sub-market

Efficiency measures in commercial buildings

The penetration of energy efficiency measures into the retail sector varies with the sub-market. Table 28 shows the penetration for various measures by sub-market. Variable air volume and economizers may not be an appropriate technology in some types of floor space, particularly strip malls and other retail and service establishments. Care needs to be taken in interpreting the data for these situations.

Overall, this table shows a fairly high penetration of efficiency measures in enclosed malls. Enclosed malls accounting for sixty-five percent or more of mall floor space have at least some of their area containing these measures.

The presence of electronic ballasts suggests the use of efficient linear fluorescent fixtures. This measure seems to be the most common energy efficiency measure. Buildings with 95 or more percent of the enclosed mall space have at least some space with this feature. This efficiency measure is found in buildings representing about two-thirds of the space of strip malls and other retail and service buildings.

Energy management appears to be common in enclosed malls but is found in only about a fifth of the space in buildings that are strip malls and other retail service buildings.

These data suggest that efforts aimed at promoting efficient lighting have been effective although there are clearly pockets in the strip mall and other retail sectors that have yet to become efficient. It is likely that these are the small owner-operated spaces. Other efficiency measures are common in space represented by enclosed malls, but measures other than lighting have made only modest inroads into strip mall and other retail locations.

Table 28 Penetration of efficiency measures in strip malls, enclosed malls, and other retail and service establishments

Measures	Strip malls		Enclosed malls		Other retail and service	
	Square feet (billions) of buildings having at least some space with	Percent of buildings with at least some space with	Square feet (billions) of buildings having at least some space with	Percent of buildings with at least some space with	Square feet (billions) of buildings having at least some space with	Percent of buildings with at least some space with
Variable air volume	0.60	15	1.10	65	0.96	13
Economizer	1.10	28	1.40	82	1.54	21
Energy management	0.70	18	1.30	76	1.82	24
Specular reflectors	1.10	28	1.10	65	2.20	29
Electronic ballasts	2.70	69	1.60	94	4.70	63
Total square feet of buildings in market	3.90		1.70		7.50	

Source: EIA, 1999 CBECS public use sample as analyzed by Innovologie, LLC.

Summary and conclusions

This chapter describes the retail and service sub-markets. Retail space can be divided into enclosed malls, strip malls, and other retail representing 14 percent, 23 percent, and

63 percent of retail and service space, respectively. Other retail space tends to be owner-occupied and relatively small in terms of square feet (mostly under 5,000 square feet). More than half of that space was built before 1960. Enclosed mall and strip mall spaces tend to be larger and leased. About 38 percent of the combined mall stock was built between 1960 and 1980. The 1980s saw rapid growth of strip malls.

An important finding is that as many as 20 percent of regional malls, mostly enclosed malls, are marginal and may need to be redeveloped or the land reused for other purposes in the next three to five years. Whatever new uses there are for the buildings or the land, there is significant opportunity to influence the energy efficiency of these buildings.

Much of the large commercial retail space is leased. There are at least three key sets of players. There are the large retail property owners, the top 50 of whom own the equivalent of 28 percent of enclosed mall and strip mall space. There are the large retail property managers, the top 50 of whom manage the equivalent of 32 percent of enclosed and strip mall space. And there are the major retailers, the top 100 of whom have about \$1.2 trillion revenues or about one-third of total U.S. retail revenues.

Most large retail property owners manage their own space. However, there are companies that specialize in retail property management who manage properties for investors or investor groups who are not in the business of managing property.

Large retail property owners lease much of their space to large retailers. The character of the space is typically spelled out in the lease documents. Property owners may develop the space to the retailers' specifications or the retailers may manage their own construction within the leased space. At one end of the spectrum, retailers may use designers to specify the basic organization of the space, the wall treatments, and lighting, heating, and cooling specifications which the owners complete and into which retailers place case-work and display racks. At the other end of the spectrum are large retailers with their own designer/contractor teams that essentially build all aspects of the interior including lighting, heating, ventilation, and cooling. Some large retailers, for example some grocery chains or supercenters, may own land directly or take a ground leases and design and build buildings to their own specifications.

The important point is that for large retailers and/or large developers, much of the decision-making is centralized. That means that promoters of energy efficiency can potentially influence the efficiency of large amounts of space by working with a relatively small number of players at either the regional or the national level. What may be required is to work with both the large retailers and the large owner developers recognizing that they influence each other. Still, the size of the target audience is relatively small. It is clear that efforts to influence efficiency for these players need to be regional and national in scope. DOE, EIA, and national and regional market transformation organizations can play important roles in this.

Large national and regional retailers and owners do work with local architects, management firms, or contractors because the local firms know the local landscape and can expedite projects. Local firms may be able to exert some control over designs and specifications when there are conflicts with local zoning regulations or building codes. However, their influence on national and regional organizations is limited.

Decision making for “other retail” is somewhat different. As we noted above, other retail is usually small and owner-operated. This means that strategies attacking this market need to be locally focused using state and local resources. DOE and EPA can help here by aiding in the development of effective local strategies for dealing with local players.

It is also important to realize that construction timelines for major retail projects are relatively short, roughly six months. Once construction has started it is generally too late to influence projects because the specifications and the purchasing are largely complete. For major retail projects, it is important to influence the design basis used by the “image architects” for retail projects. The design basis is used in the negotiations for lease space and/or for laying out space once a lease is anticipated.

There are also opportunities to change the energy characteristics of a building when retail space is remodeled. Depending on the retail space this may happen in six- to nine-year cycles.

Generally, people think of buildings as having a lifetime of half a century. In the current environment, especially for some retail buildings built in the last 20 to 30 years, it may be more appropriate to think of retail buildings as having a shorter lifespan, perhaps in the range of 20 to 30 years.

Energy technologies vary with the players. Packaged systems are typical for malls and strip malls while furnaces and other types of air conditioning are more common in other retail.

Our analysis suggests that efforts aimed at promoting efficient linear fluorescent lighting have been effective although there are clearly pockets in the strip mall and other retail sector that have yet to become efficient. It is likely that these are the small owner occupied spaces. Other efficiency measures are common in more than half of the space represented by enclosed malls, but measures other than lighting have made only modest inroads into strip mall and other retail locations. Such measures are often found in locations representing less than 30 percent of the total square footage.

Chapter 7 The Food Sales and Services Sub-Market

Introduction

The food sales and services sub-market is among the largest and most varied of the sub-markets in the commercial building market. There are approximately 400,000 buildings in this sub-market accounting for approximately two billion square feet of commercial floor space.

The food sales and services sub-market operates somewhat along the lines portrayed in Figure 60. At the top of the chain are the growers and producers. These operators are mostly accounted for in the agricultural sector and will not be discussed in this chapter. Products flow from the growers/producers to the food processing industry, the wholesalers, and in some cases, to food sales and services entities. Because many of the firms in food processing are industrial and agricultural, this chapter only briefly describes them as well. Food moves from the processing industry to wholesalers or directly to food sales and food retail establishments and chains. As we shall see shortly, there are a variety of types of wholesalers.

Below the wholesale level are the food sales and services establishments. In terms of commercial buildings, it is the structure and operation of these establishments that is of most interest.

The food sales portion of the food sales and services sub-market is referred to as “food and beverage stores” or more commonly, groceries, supermarkets, and convenience stores. This part of the sub-market is described in the Census Bureau’s North American Industry Classification System (NAICS) as:

Industries in the food and beverage stores sub-sector usually retail food and beverage merchandise from fixed point-of-sale locations. Establishments in this sub-sector have special equipment (e.g., freezers, refrigerated display cases, refrigerators) for displaying foods and beverages. They have staff trained in the processing of food products to guarantee the proper storage and sanitary conditions required by regulatory authority.

The food services portion of this sub-market are described as “food services and drinking places” and “food and beverage stores” in NAICS:

Industries in the food services and drinking places sub-sector prepare meals, snacks, and beverages to customer order for immediate on-premises and off-premises consumption. There is a wide range of establishments in these industries. Some provide food and drink only, while others provide various combinations of seating space, waiter/waitress services and incidental amenities, such as limited entertainment. The industries in the sub-sector are grouped based on the type and level of services provided. The industry groups are full service

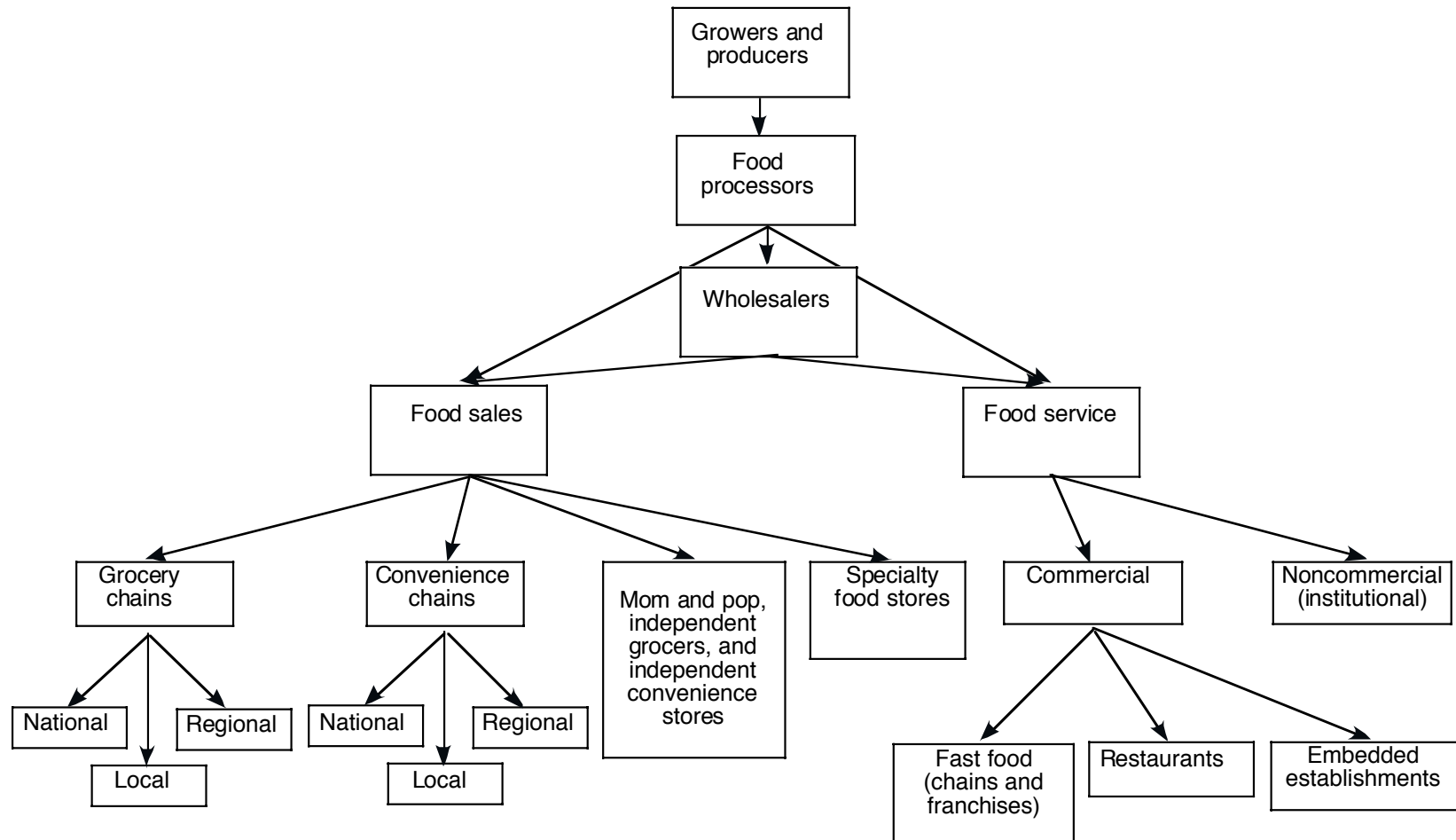
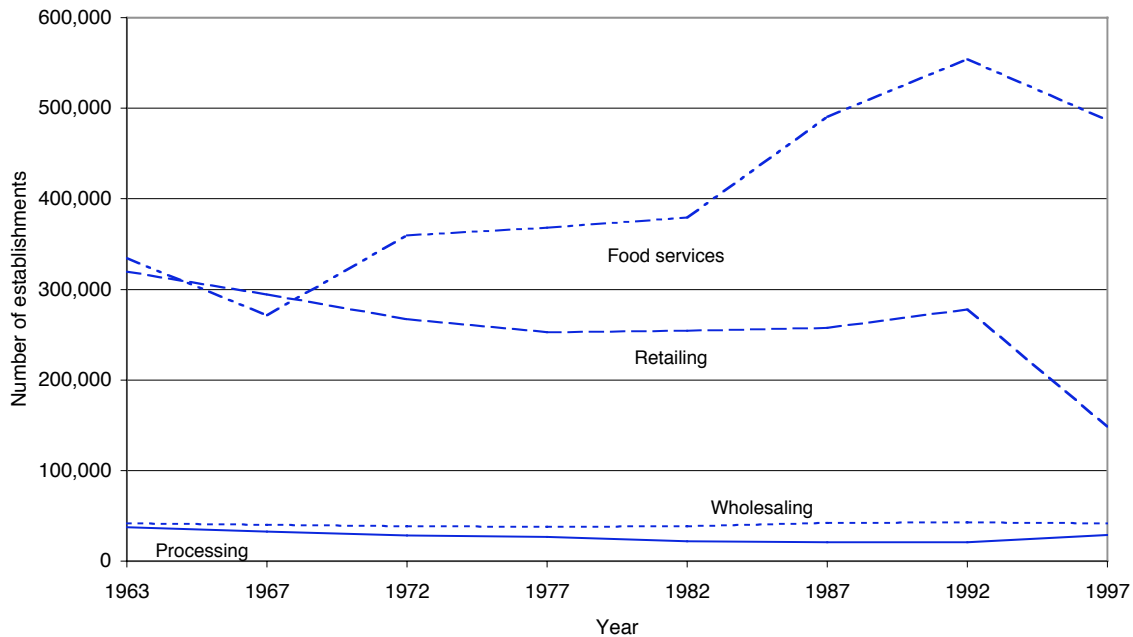


Figure 60 Organization of the food sales and services sub-market

restaurants; limited service eating places; special food services, such as food services contractors, caterers, and mobile food services; and drinking places.

The changing structure of the food sales and services sub-market

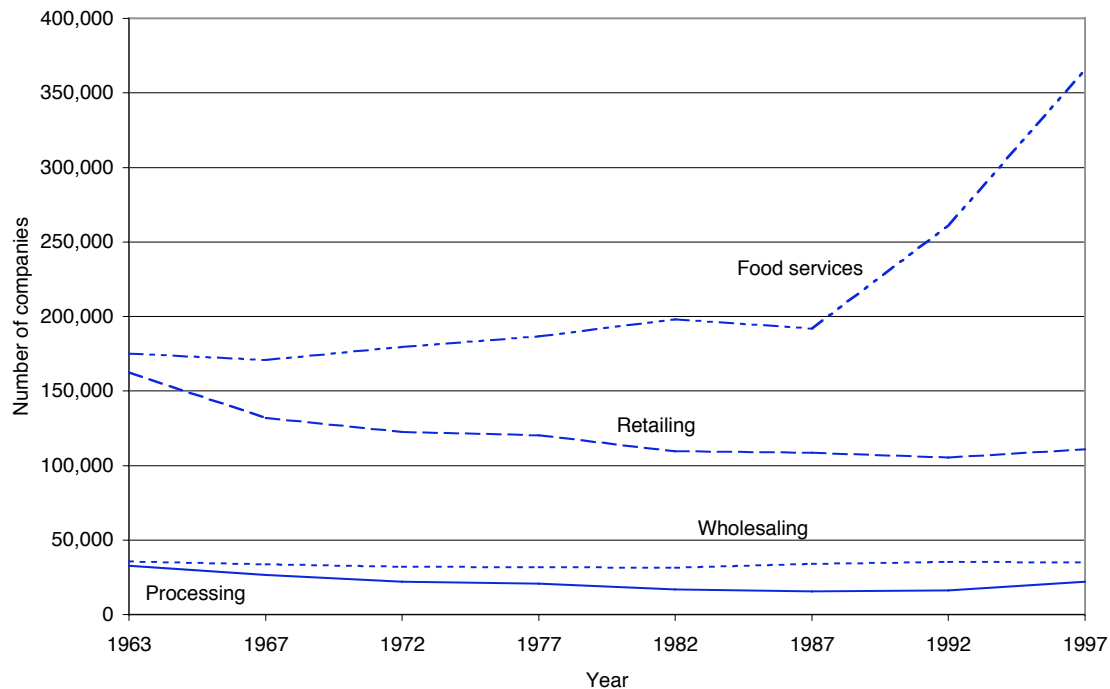
Figure 61 describes changes in the structure of the food sales and services sub-market in terms of the number of establishments. An establishment is a physical location. The number of processing establishments has declined by about a third although there was an up-tick in 1997 possibly a result of the change in Standard Industrial Classification codes to NAICS. The number of wholesale establishments has remained relatively constant while the number of retail establishments has declined. The number of food services establishments increased somewhat rapidly between 1967 and 1972 and again quite dramatically in the 1980s before declining in the 1990s. The decline may be due in part to shifts in the definitions.



Sources: Census of Manufactures, selected issues; Census of Retail Trade, selected issues; Census of Wholesale Trade, selected issues; and Census of Accommodation and Foodservices, selected issues. Note: There was a shift from the SIC code definition to the NAICS between 1992 and 1997.

Figure 61 The changing structure of the food sales and services sub-market (number of establishments)

Figure 62 presents this same data for *firms* rather than *establishments*. A firm can own multiple establishments. In general, the number of food services firms has increased. The number of processing and retailing firms has declined and the number of wholesalers has remained fairly constant. The 1997 numbers may be influenced by the shift from the use of SIC codes to NAICS codes.



Sources: Census of Manufactures, selected issues; Census of Retail Trade, selected issues; Census of Wholesale Trade, selected issues; and Census of Accommodation and Foodservices, selected issues. Note: There was a shift from the SIC code definition to the NAICS between 1992 and 1997.

Figure 62 Trends in the number of food sales and services firms

Market composition

For the most part, the production, processing, wholesaling, food sales, and food services sub-markets are comprised of different players. There is some integration especially between production and processing and wholesaling and food sales. What is most striking about the character of these different sub-markets is the degree of concentration in the sub-markets. As we shall see, fewer than 75 firms often control much of the activity and real estate in a given sub-market. From the standpoint of marketing energy efficiency, this means that one has only to address a relatively small number of players in order to have a significant impact.

Food processing industry

The food processing and beverage industry comprises approximately one-sixth of the U.S. manufacturing sector's activity.¹¹⁷ Recently, it has undergone significant reorganization with food manufacturers trying to increase income and market share through con-

¹¹⁷ U.S. Department of Commerce, *U.S. Industry and Trade Outlook 2000*, McGraw-Hill, NY, 2000. Cited in J. Michael Harris, Phil Kaufman, Steve Martinez, and Charlene Price, ERS Agricultural Economic Report No. AER811.

solidation, foreign growth, and new product development.¹¹⁸ Food manufacturing plants are also becoming more automated and integrated to achieve economies of scale.

Table 29 shows the annual sales for the top 50 American food processing companies. In

Table 29 Sales of leading food processing companies in the United States

Sales Company rank		1998 (millions of dollars)	1997 (millions of dollars)	Sales Company rank		1998 (millions of dollars)	1997 (millions of dollars)
1	Philip Morris	31,416	31,891	26	Ralston Purina Co.	2,582	2,309
2	PepsiCo, Inc.	22,348	20,917	27	International Multifoods Corp.	2,300	2,250
3	Coca-Cola Company	18,813	18,868	28	Maple Leaf Foods Inc.	2,144	2,403
4	ConAgra, Inc.	17,928	18,072	29	Wm. Wrigley Jr. Co.	2,005	1,937
5	IBP, Inc.	12,849	13,259	30	Smithfield Foods, Inc.	1,946	1,948
6	Sara Lee Corp.	10,832	10,542	31	Adolph Coors Co.	1,900	1,821
7	Anheuser-Busch	9,239	9,043	32	Warner-Lambert Co.	1,888	1,869
8	H.J. Heinz Company	9,209	9,357	33	Imperial Holly Corp.	1,853	1,958
9	Nabisco, Inc.	8,400	8,734	34	George Weston Ltd.	1,756	1,567
10	Bestfoods	8,374	8,400	35	Earthgrains Co.	1,719	1,663
11	Tyson Foods, Inc.	7,414	6,356	36	International Homefoods Inc.	1,700	1,222
12	Kellogg Company	6,762	6,830	37	McCormick and Company, Inc.	1,692	1,595
13	Campbell Soup Company	6,696	6,614	38	Canandaigua Brands, Inc.	1,497	1,212
14	General Mills	6,033	5,609	39	Brown-Forman Corp.	1,385	1,347
15	Quaker Oats Company	4,843	5,016	40	Pilgrim's Pride Corp.	1,332	1,278
16	Seagram Company	4,670	5,051	41	Fortune Brands, Inc.	1,266	1,278
17	Hershey Foods	4,436	4,302	42	Dreyer's Grand Ice Cream, Inc.	1,022	970
18	Dole Food Company	4,424	4,336	43	Michael Foods, Inc.	1,020	956
19	Procter and Gamble	4,376	4,107	44	Seaboard Corp.	1,015	1,008
20	Flowers Industries, Inc.	3,776	1,441	45	Colgate-Palmolive Co.	996	965
21	Interstate Bakeries Corp.	3,266	3,212	46	Cott Corp.	968	866
22	Hormel Foods	3,261	3,257	47	Aurora Foods, Inc.	947	874
23	Suiza Foods Corp.	2,816	1,743	48	WLR Foods, Inc.	946	995
24	Dean Foods Co.	2,736	2,461	49	Molson Companies	936	855
25	Chiquita Brands International	2,720	2,434	50	Triarc Companies, Inc.	736	556

Source: Original source, *Prepared Foods Magazine*. Reprinted in J. Michael Harris, Phil Kaufman, Steve Martinez, and Charlene Price, ERS Agricultural Economic Report No. AER811. Appendix Table 3, p 54, August 2002.

¹¹⁸ Connor, John M., and William A. Schick, *Food Processing: An Industrial Powerhouse in Transition*, Second edition, John Wiley and Sons, 1997. Cited in J. Michael Harris, Phil Kaufman, Steve Martinez,

1998, the total sales for these companies was about \$250 billion. In 1997 and 1998, Philip Morris was the largest food processing company followed by Pepsi and Coca-Cola. The rankings have undoubtedly changed in the last five years but these serve to give readers an idea of who the major players are in the food processing industry.

Although it is outside of the scope of this project, these firms could be realigned into major product categories and the key technologies that they use could be identified.

Food wholesaling industry

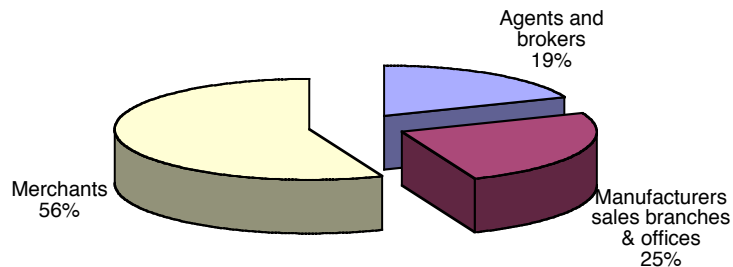
Food wholesaling can be subdivided into three groups:¹¹⁹

- Merchant wholesalers who buy products and then sell them to retailers or institutions
- Agents and brokers who act as agents for manufacturers or processors but who do not take possession of the goods
- Manufacturers who sell directly to customers through branches and offices.

Merchant wholesalers account for a bit more than half of the \$589 billion in annual sales of wholesalers with the agents and brokers comprising about a fifth and manufacturers about one-quarter (Figure 63).

Merchant wholesalers can be further subdivided into:

- Broad line distributors, sometimes referred to as general line or full line distributors, who handle food, health and beauty aids
- Specialty wholesalers who handle items such as fish, dairy and poultry
- Miscellaneous or “systems wholesalers” who dry goods such as coffee, tea, canned goods, etc.



Source; Bureau of Census, Census of Wholesale Trade 1997, U.S. Department of Commerce as presented in J. Michael Harris, Phil Kaufman, Steve Martinez, and Charlene Price, ERS Agricultural Economic Report No. AER811

Figure 63 Composition of wholesalers in the market

and Charlene Price, ERS Agricultural Economic Report No. AER811.

¹¹⁹ The typology is from Friddle, Mangaraj, and Kinsey; 2001 as cited in J. Michael Harris, Phil Kaufman, Steve Martinez, and Charlene Price, ERS Agricultural Economic Report No. AER811.

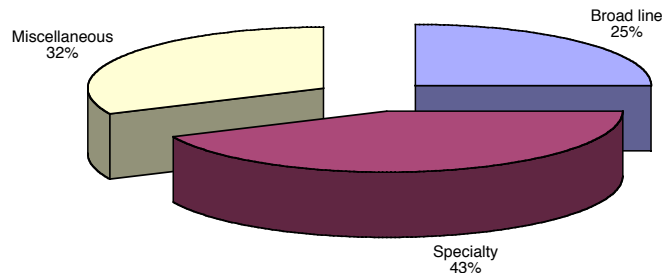
Figure 64 shows how broad line, specialty, and miscellaneous sales are distributed among merchant wholesalers. The specialty wholesalers dominate followed by the miscellaneous wholesalers.

Figure 65 shows the breakout of products among the specialty wholesalers. Packaged frozen foods predominate, followed by meat, and fresh fruit and vegetables.

The 2001 wholesale and retail sales of the top 15 broad line wholesale grocers are shown in Figure 66. Some wholesalers are in both the wholesale and retail markets, as can be seen from the stacked values in the charts, for instance, Supervalu, Fleming, and Giant Eagle.

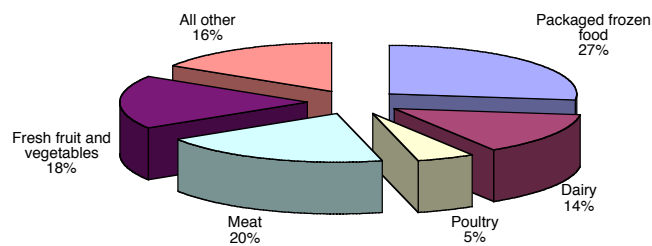
There is a fair bit of concentration occurring in the broad line market. For instance, the top four firms in the broad line market increased their market share from 26 to 41 percent between 1987 and 1997. It appears that much of this concentration is at the expense of firms in the lower part of the top 50 who actually saw their share decrease slightly.¹²⁰

Because consolidation in the food sales market caused by supermarket chains is reducing the number of customers for wholesalers, merchant wholesalers are looking for markets. Some broad line merchant distributors are responding by acquiring retail operations. Roundy's is an example.



Source; Bureau of Census, Census of Wholesale Trade 1997, U.S. Department of Commerce as presented in J. Michael Harris, Phil Kaufman, Steve Martinez, and Charlene Price, ERS Agricultural Economic Report No. AER811.

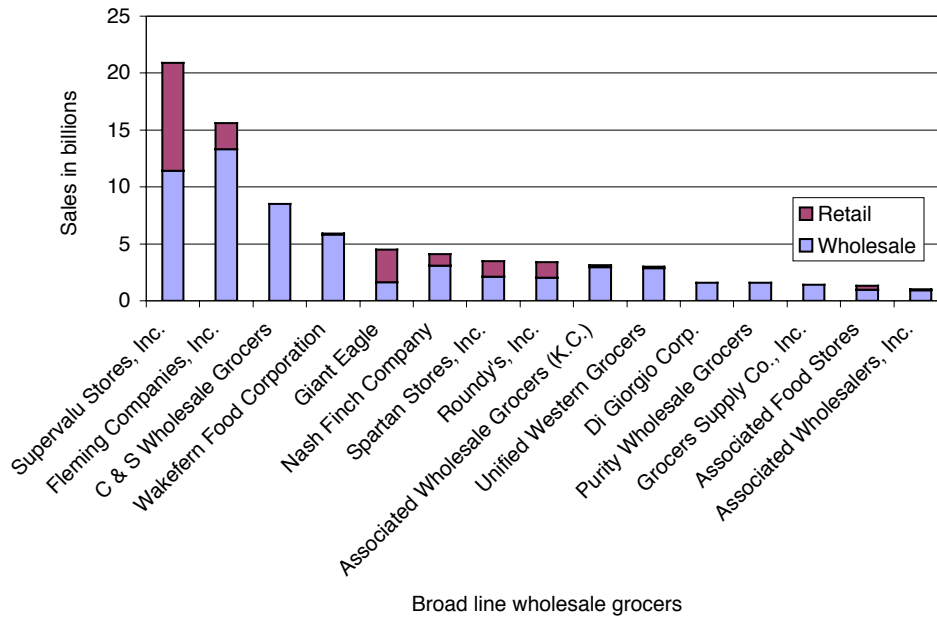
Figure 64 Relative sizes of merchant wholesaler categories



Source; Bureau of Census, Census of Wholesale Trade 1997, U.S. Department of Commerce as presented in J. Michael Harris, Phil Kaufman, Steve Martinez, and Charlene Price, ERS Agricultural Economic Report No. AER811.

Figure 65 Types of wholesale establishments

¹²⁰ See appendix table 17 , p. 66 in, J. Michael Harris, Phil Kaufman, Steve Martinez, and Charlene Price, ERS Agricultural Economic Report No. AER811.



Sources: Supermarket News, various issues; Food Institute Report, various issues; selected issues; American Institute of Food Distribution, Inc.; Progressive Grocer Annual Report, April 2001; Wall Street Journal, Company 10K's filed with the Security and Exchange Commission. Data compiled and displayed in J. Michael Harris, Phil Kaufman, Steve Martinez, and Charlene Price, ERS Agricultural Economic Report No. AER811, p. 16.

Figure 66 Top 15 broad line wholesale grocers in the United States

Another group of wholesalers are those who distribute to institutions (Table 30). Here, there are two dominant players, Sysco Corporation and U.S. Food Service. The third, fourth, and sixth ranked players are growing at a rapid rate although they are starting from a small base.

We cannot leave the discussion of food wholesalers without touching on the wholesale clubs. In the five-year period between 1995 and 2000, the revenues for Costco, Sam's and BJ's have increased by nearly 50 percent from \$40 billion to \$60 billion (Figure 67). Costco has been particularly aggressive, nearly doubling its sales. While these hybrid wholesalers sell a wide variety of goods including office supplies, electronics, tools, and clothing, a significant share of their sales derive from food stuffs including fruits and vegetables, frozen foods, beverages, meats, dry grains, and tinned goods. A segment of their customers are small food services vendors and organizations and institutions who find it easier and perhaps even cheaper to deal with these wholesalers than with other types of wholesalers.

Because wholesaling is broader than food wholesaling, the discussion of building characteristics for wholesalers is deferred to the chapter on wholesalers.

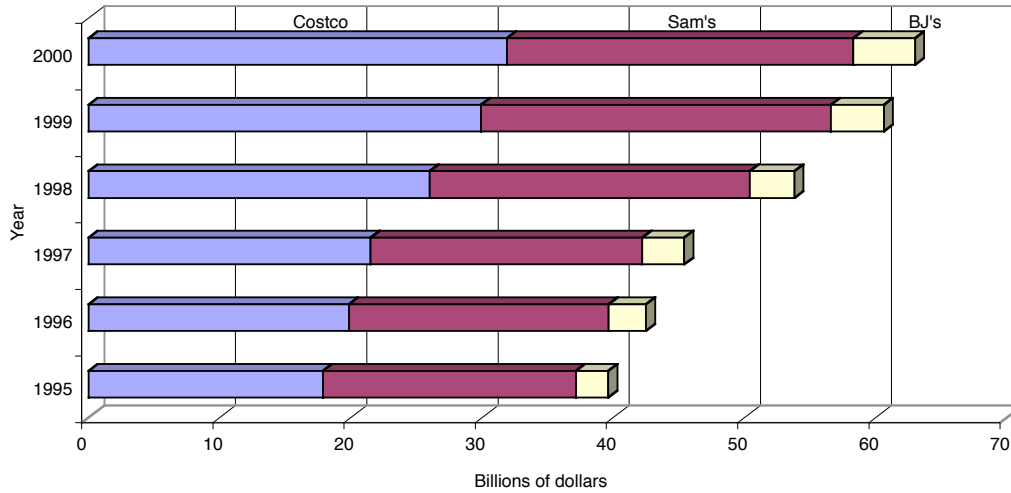
Table 30 Top 10 institutional distributors in billions of dollars

Firms	1995	1996	1997	1998	1999	2000	001
Sysco Corporation	12.7	14.1	14.8	16.1	18.3	20.6	22.6
U.S. Food Service (JP Food-service, Inc.) ¹	11.1	8.3	13.0	14.6	15.6	18.6	17.7
Performance Food Group	0.7	0.7	1.2	1.6	2.1	2.6	3.2
Gordon Food Service, Inc.	1.3	1.5	1.7	1.8	2.0	2.3	2.8
Food Services of America	0.9	1.0	1.0	1.1	1.2	1.3	1.3
Reinhart Food Service	0.4	0.5	0.6	0.6	0.7	1.1	1.3
Shamrock Foods Co.	0.6	0.7	0.8	0.8	0.9	1.0	1.0
Maines Paper & Foodservice	0.4	0.4	0.4	0.4	0.5	0.8	1.0
Ben E. Keith Foods	0.3	0.3	0.4	0.4	0.5	0.6	0.7
The IJ Co.	ne	ne	ne	ne	ne	ne	0.6
Total	28.4	27.5	33.9	37.4	41.8	48.9	52.2

¹ Includes JP Foodservice's acquisition of U.S. Foodservice, Inc. and U.S. Food Service's (a subsidiary of Ahold) acquisitions of PYA/Monarch, Inc., and Alliant Foodservice, Inc. (formerly Kraft Foodservice).

ne New entrant. A consistent time series was not maintained for this company in earlier years as it was a new entrant into the top 10 in 2001.

Sources: *Institutional Distribution*, various issues; *Food Institute Report*, various issues; just-food.com. Data compiled and displayed in J. Michael Harris, Phil Kaufman, Steve Martinez, and Charlene Price, ERS Agricultural Economic Report No. AER811, p. 18.



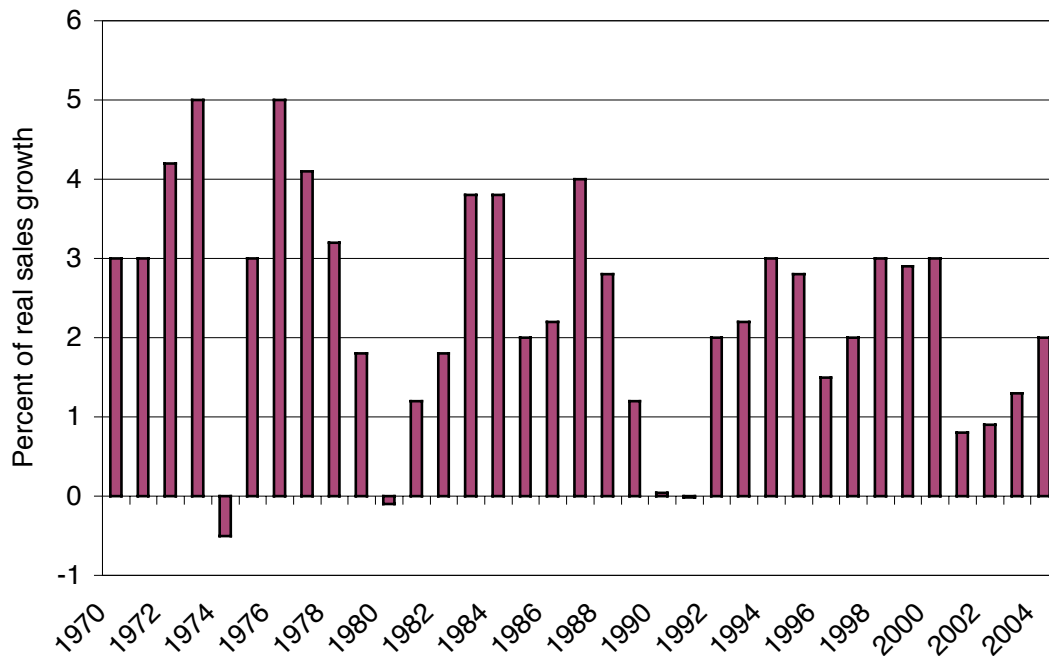
Sources: Food Institute Report, various issues; and www.warehouseclubfocus.com; and as reported in J. Michael Harris, Phil Kaufman, Steve Martinez, and Charlene Price, ERS Agricultural Economic Report No. AER811, p. 19.

Figure 67 Wholesale club revenues in billions of dollars 1995 - 2000

Food services

The National Restaurant Association describes this sub-market as one of the “cornerstones” of the American economy. The food services sub-market continues to grow both in terms of sales and employment. Currently, there are 878,000 restaurants in the United States, nearly double from the 1972 level of 491,000 establishments. Projected 2004 sales are expected to exceed \$440 billion. This represents 46 percent of the nation’s food dollar. The sub-market employs more than 12 million people about 9 percent of the US workforce and the sector as a whole is expected to continue as the nation’s “largest private employer.”¹²¹

Figure 68 shows the annual sales growth in this sub-market for the last three decades. Between 1970 and 2002, restaurant industry sales posted a compound annual growth rate of 7.3 percent. Although the restaurant industry reported the strongest growth in the 1970s, the last decade has seen steady with modest growth rates from slightly less than one to three percent. The few instances of negative or zero growth have been in periods when the economy was at low ebb.



Sources: 2004 Restaurant Industry Forecast: Executive Summary. Washington DC, National Restaurant Association, 2004. <http://www.restaurant.org/research/forecast.cfm> last accessed March 18, 2004.

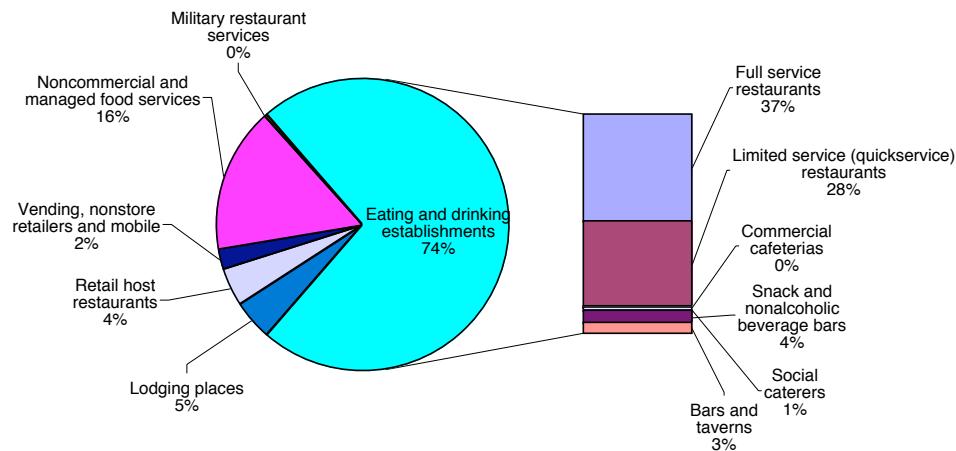
Figure 68 Restaurant industry real sales growth, 1971 – 2004

¹²¹ 2004 Restaurant Industry Forecast: Executive Summary. Washington DC, National Restaurant Association, 2004, p. 1. <http://www.restaurant.org/research/forecast.cfm> last accessed March 18, 2004.

The 878,000 establishments can be divided among commercial, non-commercial and military operations. In terms of sales, 92 percent of the sales are in the commercial sector and 8 percent in the noncommercial and military restaurant sectors.¹²²

Figure 69 shows a breakout of the roughly \$440 billion of sales in the commercial non-commercial and military sectors for 2004. Seventy-four percent of the sales went to what are called “eating and drinking establishments” meaning that they were standalone eating and drinking places that were not embedded within some other type of establishment. Of these, half were full service restaurants and 28 percent were quick service restaurants. The remainder is standalone bars, lunchrooms, with cafeterias and caterers. Some of the full service restaurants and most of the quick service restaurants are franchise operations. When these are combined more than half of the eating and drinking places are franchise operations.

After the eating and drinking places, the next highest percentage of places is noncommercial and managed food services. These establishments account for \$70 of the total of \$440 billion. Figure 70 shows the breakout of these services. These include hospitals, nursing homes, colleges and universities, work places, schools, recreational venues, and airlines.

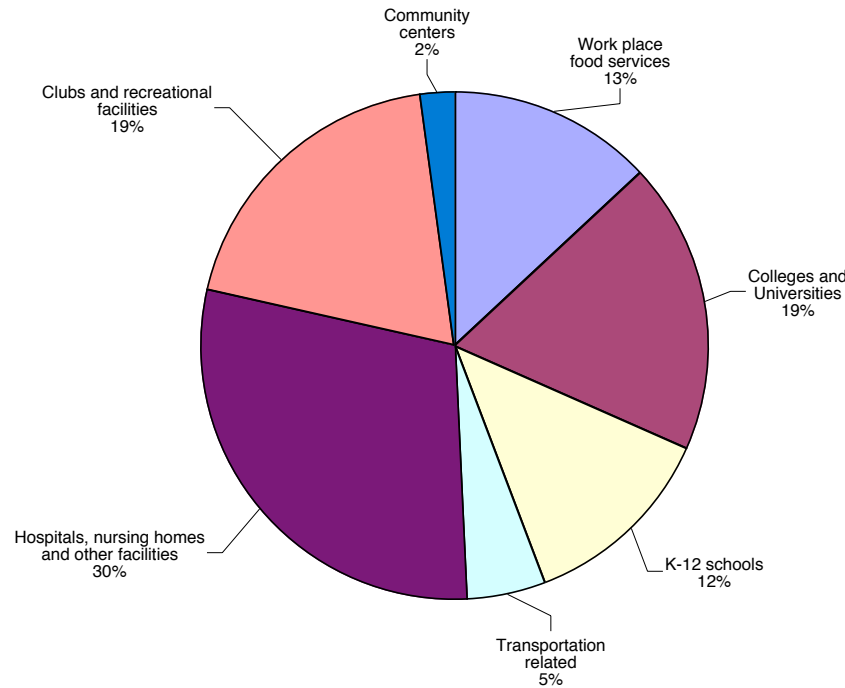


Sources: 2004 Restaurant Industry Forecast: Executive Summary. Washington DC, National Restaurant Association, 2004, p. 3. <http://www.restaurant.org/research/forecast.cfm> last accessed March 18, 2004.

Figure 69 Year 2004 commercial food services sales by type of establishment

¹²² *Ibid.*, p 1.

Lodging places, retail host restaurants, and vending and non store retailers, along with the military round out the food services sector. Ninety-five percent of the lodging sub-market is hotel restaurants while the remainder is motel/hotel restaurants, or motel restaurants. The retail host restaurants are eating establishments found in places such as malls or department stores. Finally, the military is less than one percent of the whole.



Sources: 2004 Restaurant Industry Forecast: Executive Summary. Washington DC, National Restaurant Association, 2004, p. 3. <http://www.restaurant.org/research/forecast.cfm> last accessed March 18, 2004.

Figure 70 Year 2000 noncommercial food services sales by type of organization

Food services demographics

The typical person (age eight and older) consumes an average of 4.2 meals prepared away from home per week, or 218 meals per year.¹²³ In 2002, more than 54 billion meals were eaten in restaurants and school and work cafeterias. The average annual expenditure for food away from home in 2000 was \$2,137 per household, or \$855 per person.¹²⁴ The American diner is spending nearly half of each consumer food dollar (46 percent) eating in restaurants, up from a quarter of food dollars in 1955.¹²⁵

¹²³ Robert Ebbin, "American's Dining-Out Habits" *Restaurants USA*, November 2000. Last accessed on March 18 2004.

¹²⁴ Robert Ebbin, "Midwest Tops in Restaurant Spending," *Restaurants USA*, July 2002. Last accessed on March 18, 2004.

¹²⁵ 2004 Restaurant Industry Forecast: Executive Summary. Washington DC, National Restaurant Association, 2004, p. 2. <http://www.restaurant.org/research/forecast.cfm> last accessed March 18, 2004.

The amount of money Americans allocate for food away from home is growing steadily. Expenditures on food away from home rose 5.7 percent between 1997 and 1998, while consumer expenditures on food at home declined 3.6 percent. Households in metropolitan areas tend to spend more on food away from home than households located in non-metropolitan areas.¹²⁶

Driving this growth is the changing American consumer.¹²⁷ According to a survey conducted by the National Restaurant Association in October 2001, most consumers are so busy that convenience is critical. Roughly 30 percent of consumers agree that meals prepared at a restaurant or quick service establishment are essential to the way they live. A similar proportion agreed that purchasing takeout is essential to their lifestyles. This trend is likely to continue, according to the National Restaurant Association.

Lunch accounts for half of the typical individual's average commercial-meal consumption. On average, a person consumes 2.1 commercially prepared lunches per week, resulting in 26.7 billion commercially prepared lunches annually.¹²⁸

According to *Quickservice Restaurant Trends—2001*, one-half of their survey respondents between the ages of 18 and 24 said they eat on the go more frequently than they did two years ago in order to maintain their busy schedules.

Trend such as rising numbers of working mothers, dual-income families, smaller families, and older first-time parents will likely result the younger generation continuing the increase in eating out. Restaurant patrons, especially those with children and dual incomes, use restaurants as a way to add some fun and mitigate the pressures of their busy lives.¹²⁹

Growing rise in takeout foods

It is estimated that in 1997, takeout was a \$126 billion industry. Takeout is growing rapidly and by 2007 it is expected to increase by 55 percent to 195 billion. During that period, the growth of off-premise sales is expected to be triple the on-site sales.¹³⁰ Three out of five consumers reported that they would eat on the premises of quick service restaurants in 2002 about as often as they did in 2001. Seventy percent said they would maintain the same level of takeout and delivery food purchases in 2002.¹³¹

Even so, takeout foods are becoming a larger part of everyday life, and more Americans consider restaurants essential to the way they live. Creative restaurateurs and other food

¹²⁶ Robert Ebbin, "Midwest Tops in Restaurant Spending," *Restaurants USA*, July 2002. Last accessed on March 18, 2004.

¹²⁷ As cited in, Karen Gardner, "The Boomer Echo," *Restaurants USA*, March 1997

¹²⁸ Robert Ebbin, "American's Dining-Out Habits" *Restaurants USA*, November 2000. Last accessed on March 18 2004.

¹²⁹ Karen Gardner, "The Boomer Echo," *Restaurants USA*, March 1997. Last accessed on March 18 2004.

¹³⁰ Donna Oetzel, "All Signs Point to Takeout Taking Off," *Restaurants USA*, June/July 1999. Last accessed March 18, 2004.

¹³¹ Robert, Ebbin, "Quickservice Business on the Rise", *Restaurants USA*, August 2002. Last accessed March 18, 2004.

retailers who offer takeout options are becoming American consumers' kitchen-on-the-go.¹³²

During the 1990s and into the new century consumers have increasingly made use of takeout food including drive-thru and home delivery. Full service restaurants are increasing offering takeout options. The share of full service establishments offering takeout was 45 percent in 1987, 52 percent in 1992, and 50 percent in 1997.¹³³

Off-premise sales of meals and snacks were 7.5 percent of total sales at full service restaurants in 1997, up from five percent in 1987. At quick service restaurants, off-premise sales were 62 percent of total volume compared to 55 percent in 1987. Off-premise sales totaled nearly \$8.5 billion at full service restaurants in 1997 versus \$50.6 billion at quick service restaurants.¹³⁴

According to a consumer study conducted for the National Restaurant Association, takeout foods are quite common in most U.S. households today with three-quarters (78 percent) of U.S. households making at least one carryout or delivery purchase in a typical month. Twenty-one percent of adults who purchase takeout are daily customers but they are responsible for 51 percent of takeout occasions. Daily and frequent users, who nearly average a daily takeout purchase, account for 80 percent of the takeout business.¹³⁵

Daily users are characteristically young, mobile, and men rather than women. Frequent users favor carryout from fast-food restaurants and delivery and tend to be young couples and young parents living in newly formed households facing time pressures of work and family.¹³⁶ According to the Association's *Dinner Decision Making—1996*, 12 percent of carryout dinner occasions and 18 percent of delivery occasions in 1996 were motivated by an attempt to please children.¹³⁷

From the perspective of energy use, there are probably three important points.

- Eating out will continue to increase, meaning the expansion of food establishments will increase.
- Takeout will increase, which may result in changes in the types of buildings being used as food establishments. Already some takeout pizza operations have separated the takeout kitchens from the eat-in stores. This may result in reductions in the square footage of takeout establishments with concomitant changes in energy use for cooling, heating, and lighting. It also has siting implications. The ideal location for a takeout establishment may not be near large commercial enterprises but in areas with good road access to residential neighborhoods.

¹³² Susan Mills, "Tracking Takeout," *Restaurants USA*, June/July 1998. Last accessed March 18, 2004.

¹³³ Research Department, "Fullservice Steams Ahead," *Restaurants USA*, October 2001. Last accessed March 18, 2004.

¹³⁴ *Ibid.*

¹³⁵ Susan Mills, "Tracking Takeout," *Restaurants USA*, June/July 1998. Last accessed on March 18, 2004.

¹³⁶ *Ibid.*

¹³⁷ Karen Gardner, "The Boomer Echo," *Restaurants USA*, March 1997. Last accessed on March 18, 2004. National Restaurant Association © Copyright. All rights reserved

- The editor and chief of a publication *Takeout Business* believes that there is a cultural shift underway in which cooking at home will be viewed as quaint and that preparing food will have the status of an avocation like woodworking.¹³⁸
- The trend toward eating out and takeout may increase household energy use in terms of mobility fuels and may change internal household energy use patterns in other ways.

The players in the market

Food services chains are a significant portion of the overall food services market. Table 31 shows the top 25 food services companies in 2000 in terms of sales and number of U.S. locations. These 25 companies with their 62 chains account for one-third of commercial food services sales and more than three-quarters (78 percent) of the fast-food sales in this country. These companies also represent 12 percent of the total number of food establishments in the country. McDonald's Corporation and Tricon global are the leaders accounting for nearly 28 percent of fast-food that is sold.

Table 31 Food services chains

Rank	Company/Chain	U.S. sales (\$ millions)	U.S. locations
1	McDonald's Corporation	20,415.8	13,771
	McDonald's	19,572.8	12,804
	Boston Market	626.0	707
	Donatos Pizza	150.0	156
	Chipotle Mexican Grill	67.0	104
2	Tricon Global Restaurants, Inc.	14,500.0	20,037
	Taco Bell	5,100.0	6,746
	Pizza Hut	5,000.0	7,927
	KFC	4,400.0	5,364
3	Diageo PLC	8,619.9	8,558
	Burger King	8,542.9	8,326
	Haagen-Daz	77.0	230
4	Wendy's International, Inc.	5,837.1	5,215
	Tim Hortons	80.1	120
	Wendy's Old Fashioned Hamburg- ers	5,757.0	5,095
5	Darden Restaurants, Inc.	3,825.5	1,109
	Bahama Breeze	100.0	19
	The Olive Garden	1,644.8	463
	Red Lobster	2,071.7	620
	Smokey Bones BBQ	9.0	7

¹³⁸ Donna Oetzel, "All Signs Point to Takeout Taking Off," *Restaurants USA*, June/July 1999. Last accessed March 18, 2004.

Rank	Company/Chain	U.S. sales (\$ millions)	U.S. loca- tions
6	Doctor's Associates, Inc.	3,800.0	12,253
	Subway	3,800.0	12,253
7	Allied Domecq	3,092.7	6,416
	Baskin-Robbins	576.7	2,439
	Dunkin' Donuts	2,324.2	3,643
	Togo's Eatery	189.8	334
8	CKE Restaurants, Inc.	3,074.3	3,596
	Carl's Jr.	927.0	945
	Hardee's	2,050.0	2,526
	Taco Bueno	97,316	125
9	International Dairy Queen, Inc.	2,965.6	5,319
	Dairy Queen	2,898.6	5,058
	KarmelKorn	6.0	31
	Orange Julius of America	61.0	230
10	Brinker International	2,805.3	1,014
	Brinker Specialty Restaurants	58.0	13
	Chili's Grill & Bar	1,695.3	648
	Corner Bakery	107.3	60
	Cozymel's	40.2	13
	Maggiano's	120.2	13
	On the Border	298.3	116
	Romano's Macaroni Grill	486.0	151
11	Domino's, Inc.	2,647.2	4,818
	Domino's Pizza	2,647.2	4,818
12	Applebee's International, Inc.	2,624.6	1,251
	Applebee's Neighborhood Grill & Bar	2,624.6	1,251
13	Advantica Restaurant Group	2,602.3	2,071
	Carrows	182.7	141
	Coco's	255.6	179
	Denny's	2,164.0	1,751
14	Triarc Companies, Inc.	2,409.9	3,153
	Arby's	2,409.9	3,153
15	Outback Steakhouse, Inc.	2,254.0	702
	Carrabba's Italian Grill	217.0	81
	Fleming's Prime Steakhouse	21.0	10
	Outback Steakhouse	2,016.0	611
16	AFC Enterprises	2,003.6	2,962
	Church's Chicken	698.7	1,218
	Cinnabon	171.4	389

Rank	Company/Chain	U.S. sales (\$ millions)	U.S. loca- tions
	Popeyes Chicken & Biscuits	1,095.5	1,248
	Seattle's Best Coffee	38.0	107
17	Jack in the Box, Inc.	1,983.3	1,666
	Jack in the Box	1,983.3	1,666
18	Starbucks Corporation	1,892.0	2,962
	Starbucks	1,892.0	2,962
19	CBRL Group, Inc.	1,857.7	519
	Camine's Gourmet Market	19.9	3
	Cracker Barrel Old Country Store	1649.2	434
	Logan's Roadhouse	192.0	82
20	Sonic Corp.	1,811.4	2,219
	Sonic Drive-Ins	1,811.4	2,219
21	Papa John's International, Inc.	1,669.0	2,533
	Papa John's	1,669.0	2,533
22	Carlson Restaurants Worldwide	1,530.2	500
	Carlson Specialty Restaurants	41.0	15
	Italianni's	9.2	4
	T.G.I. Friday's	1,480.0	481
23	Metromedia Restaurant Group	1,334.1	867
	Bennigan's	525.0	259
	Ponderosa/Bonanza	635.0	500
	Steak and Ale	175	108
24	Little Caesar Enterprises, Inc.	1,300.0	3,300
	Little Caesars	1,300.0	3,300
25	Shoney's, Inc.	1,217.5	1,023
	Captain D's	495.3	564
	Shoney's	722.2	459
Total		98,073.0	107,834

Source: Technomic, Inc.

As we discussed earlier, chains and franchises typically have internal managers who are responsible for the construction and operation of facilities, and these individuals usually make use of “image architects” and other professionals. From an energy efficiency perspective, the concentration of ownership among chains and franchises means that there are a small number of decision makers who control or influence what happens in a large numbers of establishments and it is these decision makers who must be identified and addressed.

There is, however, a catch. Food services chains typically both own some establishments and sell franchises that are operated by others. McDonald's is a good example. The parent company owns about two thousand of the 13 thousand units. On average, the top 50 chains own about 20 percent of their establishments (see Table 32). Rates of ownership vary from zero to 100 percent. The median is 23 percent. Clearly the parent chain com-

panies are an important source of information, technical assistance, and training, with respect to construction and operational improvements. The level of standard settings and controls may vary significantly. Even if the franchisees are included as part of the decision-making group, the number of decision makers relative to the number of establishments is relatively small.

Table 32 Company and franchisee ownership within chains

2002Chain (2001 rank) Rank	Total units	Number of franchisee units	Number of company units	Percent company units
1 McDonald's (1)	13,099	11,154	1,945	14
2 Burger King (2)	8,306	7,776	530	6
3 Wendy's (3)	5,315	4,219	1,096	20
4 Taco Bell (4)	6,444	5,179	1,265	19
5 Pizza Hut (5)	7,719	5,974	1,745	22
6 KFC (6)	5,399	4,125	1,274	23
7 Subway (7)	13,101	13,100	1	0
8 Domino's Pizza (8)	4,869	4,243	626	12
9 Arby's (9)	3,198	3,198	0	0
10 Dairy Queen (12)	4,989	4,927	62	1
11 Jack in the Box (11)	1,762	331	1,431	81
12 Sonic Drive-In (13)	2,359	1,966	393	16
13 Hardee's (10)	2,295	1,546	749	32
14 Papa John's Pizza (14)	2,589	1,988	601	23
15 Little Caesars Pizza (15)	3,065	2,990	75	2
16 Chick-fil-A (16)	1,014	976	38	3
17 Popeyes (17)	1,327	1,231	96	7
18 Carl's Jr. (18)	926	483	443	47
19 Long John Silver's (20)	1,194	449	745	62
20 Church's Chicken (21)	1,242	845	397	32
21 Boston Market (19)	657	0	657	100
22 Chuck E. Cheese's (23)	395	48	347	87
23 Whataburger	565	262	303	53
24 Checkers Drive-In/Rally's (24)	606	606		0
25 White Castle (28)	359	0	359	100
26 Steak 'n Shake (26)	388	56	332	85
27 Panera Bread/St. Louis Bread Co. (35)	369	259	110	29
28 Captain D's Seafood (25)	562	220	342	60
29 Sbarro (27)	857	241	616	71
30 Schlotzsky's Deli (29)	668	639	29	4
31 Fazoli's (30)	392	212	180	45
32 Krystal (32)	411	165	246	59

2002 Chain (2001 rank) Rank	Total units	Number of franchisee units	Number of company units	Percent company units
33 Round Table Pizza (N/A)	508	456	52	10
34 Einstein/Noah's Bagels (31)	465	12	453	97
35 Del Taco (34)	392	141	251	64
36 El Pollo Loco (38)	293	157	136	46
37 CiCi's Pizza (39)	375	344	31	8
38 Bojangle's (40)	289	140	149	51
39 Panda Express (41)	460	72	388	84
40 Papa Murphy's Take 'N Bake Pizza (42)	694	686	8	1
41 Blimpie Subs (36)	1,894	1,893	1	0
42 Godfather's Pizza (33)	565	470	95	16
43 In-N-Out Burger (N/A)	158	0	158	100
44 A&W Restaurants (37)	822	678	144	17
45 Buffalo Wild Wings (N/A)	158	105	53	33
46 Mrs. Winner's/Lee's Famous (43)	332	195	137	41
47 Au Bon Pain (44)	198	60	138	69
48 Wienerschnitzel & Hamburger Stand (N/A)	342	277	65	19
49 Taco John's (45)	414	405	9	2
50 Chipotle (N/A)	177	0	177	100
Totals	104,977		19,478	

Source: QSR Online, http://www.qsrmagazine.com/qsr50/2002/charts/systemwide_sales.html.

The restaurant and lunchroom portion of the commercial food services sector is a different story. That part of the market is dominated by small single-unit operations. For example,

- More than seven out of ten eating-and-drinking places are single-unit (independent) operations.
- Eating and drinking places employ more minority managers than any other industry.
- Eating and drinking places rank second, based on sales volume, among retail establishments owned by African Americans and Hispanics.
- The number of African American owned and women owned eating and drinking places increased at double digit rates during the past decade with sales rising dramatically as well.

From the perspective of trying to improve the energy efficiency of this part of the industry, there are many more owners to be reached. Further, these operations are small, and energy efficiency may be a lower priority than issues such as staffing, food preparation, and general management.

Trends in the restaurant industry

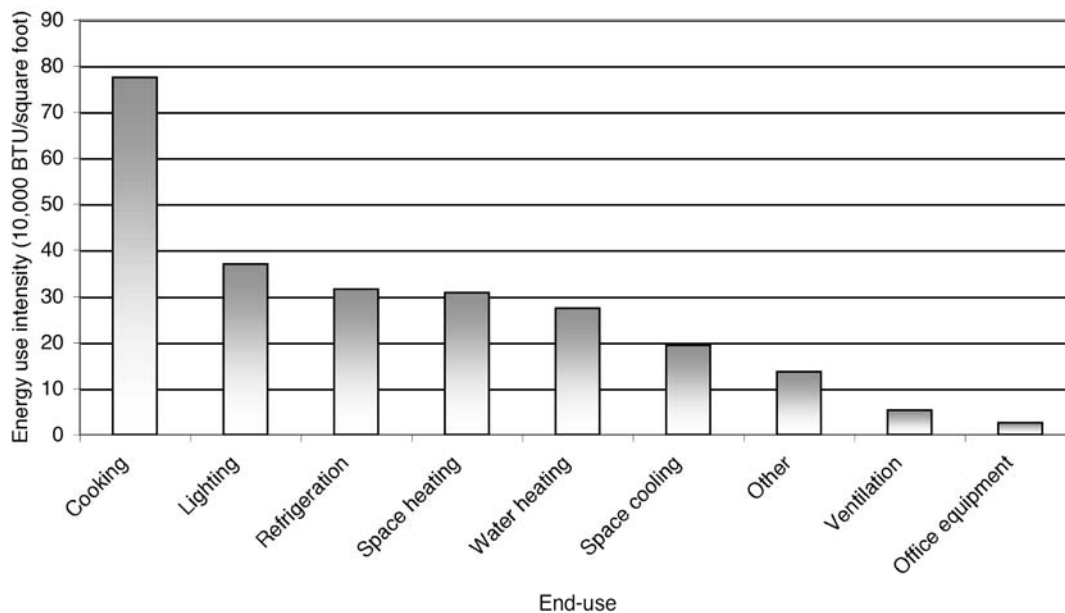
The restaurant industry faces intense competition amidst slowing sales growth with increased emphasis on operating cost control. Business costs, especially labor, are rising and therefore operators are seeking offsets to maintain and enhance their profit margins. Restaurants feel the need to “remodel” on a frequent basis to maintain facility appearance. Although some major chains are self-financing, most chains, their subsidiary franchises, and independents require some form of external capital for improvements and expansions.¹³⁹

High energy prices continue to affect the operating revenues and expenses in restaurants. During the 12 months ending January 2001, natural-gas prices for commercial establishments jumped 76 percent¹⁴⁰.

Electricity is the largest utility expense for most restaurants; gas ranks second. Together, these utility expenses usually account for two to three percent of a typical restaurant's sales dollar. Thus, in terms of costs, energy efficiency is not likely to be one of the first places to which restaurants look in terms of cost cutting. However, significant and unanticipated changes in energy prices can adversely affect a restaurant's profitability.

Energy end-use intensities and equipment in the food services market

Not surprisingly, Figure 71 shows that cooking (770,000 Btus per square foot) is the major energy end-use in the food services sub-market. Lighting, refrigeration, space heating, water heating, space cooling, other, ventilation, and office equipment



Source: EIA, CBECS 1995

Figure 71 End-use energy intensities in the food services segment

¹³⁹ Source: Commercial Buildings Initiative, *Target Market Priorities*, NEEA, Schick Consulting and Pacific Energy Associates, 2002, pg. 24)

ing, and water heating also contribute significantly to energy consumption. These end-uses each contribute about 40 percent of the value of cooking. If one combines space heating, cooling, and ventilation, then space conditioning is the second largest use, at 600,000 Btus per square foot annually or about three-quarters of the level of cooking.

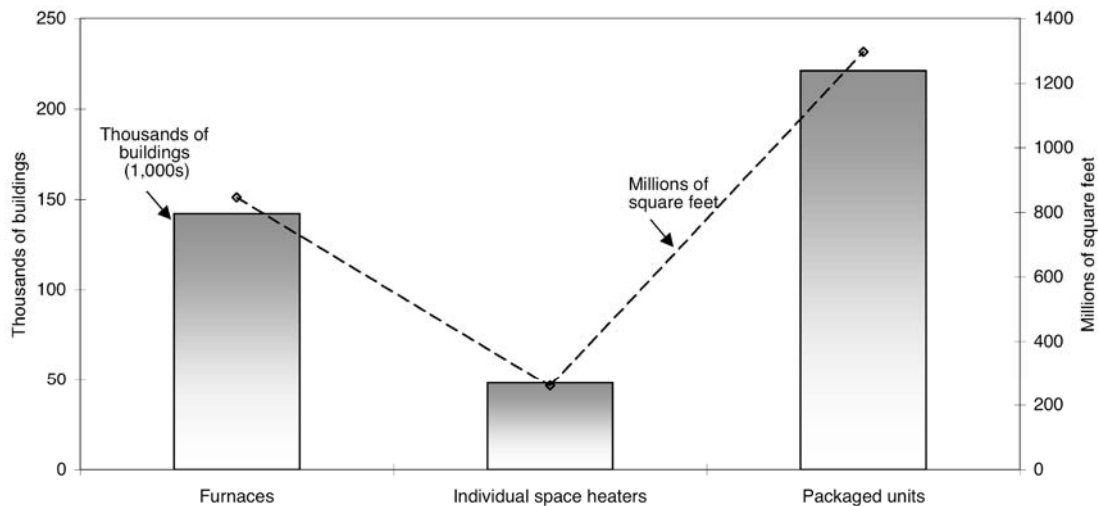
There is not a lot of information available about cooking equipment in the food services area. It is unclear to what extent energy use for cooking might be reduced, but potentially it is an area where reductions could be made.

Cooking is clearly associated with producing healthful, flavorful food in a timely manner. Thus, the drivers for changes to cooking equipment are likely to be non-energy benefits that come from labor savings, improved taste and quality of food, and healthful preparation. This is an area where it might be appropriate to partner with hospitality schools, cooking schools, utilities such as Pacific Gas and Electric Company that has a food services center, and large chains to explore options for improving energy efficiency in cooking.

There may also be opportunities for the use of waste heat recovery from cooking and refrigeration to heat or preheat water and to reduce space heating and cooling loads.

Heating and cooling equipment

The majority of the 1.85 billion square feet of floor space in the food services sub-market (93 percent) is heated. Packaged units heat 900 million square feet or about 48 percent of the space. Furnaces are used to heat about 31 percent of the floor space in about 95,000 establishments. Individual units are used in the remaining 14 percent of heated space. It is likely that furnaces are used in older buildings and that newer buildings tend to be heated with packaged units.

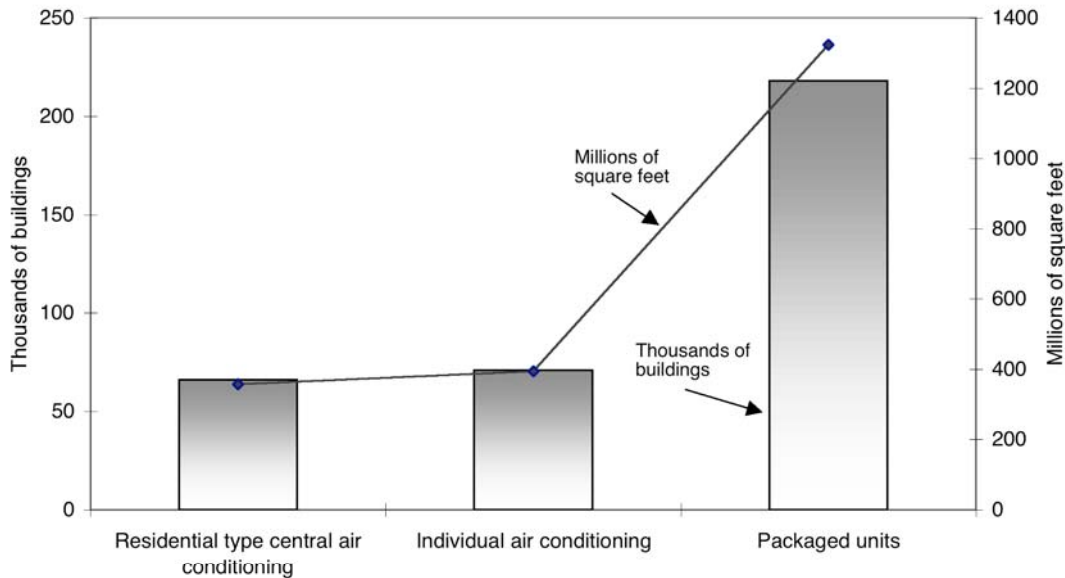


Source: EIA, CBECS 1999 Tables B32-B33

Figure 72 Types of heating equipment installed in the food services sub-market

¹⁴⁰ Bruce Grindy, *Energy Prices Skyrocket*, *Restaurants USA*, April 2001

Ninety-three percent of the buildings and 95 percent of the total floor space in this sub-market is cooled. In the food services sub-market, buildings (Figure 73) with 71 percent of the floor space have at least some areas of the buildings cooled with packaged units. Buildings representing about 20 percent of the floor space have at least some cooling from residential type central air conditioning units and about an equal percentage have at least some cooling from individual air conditioning units. Obviously, food services establishments often have more than one type of air conditioning equipment.



Source: EIA, CBECS 1999 Tables B34-B35

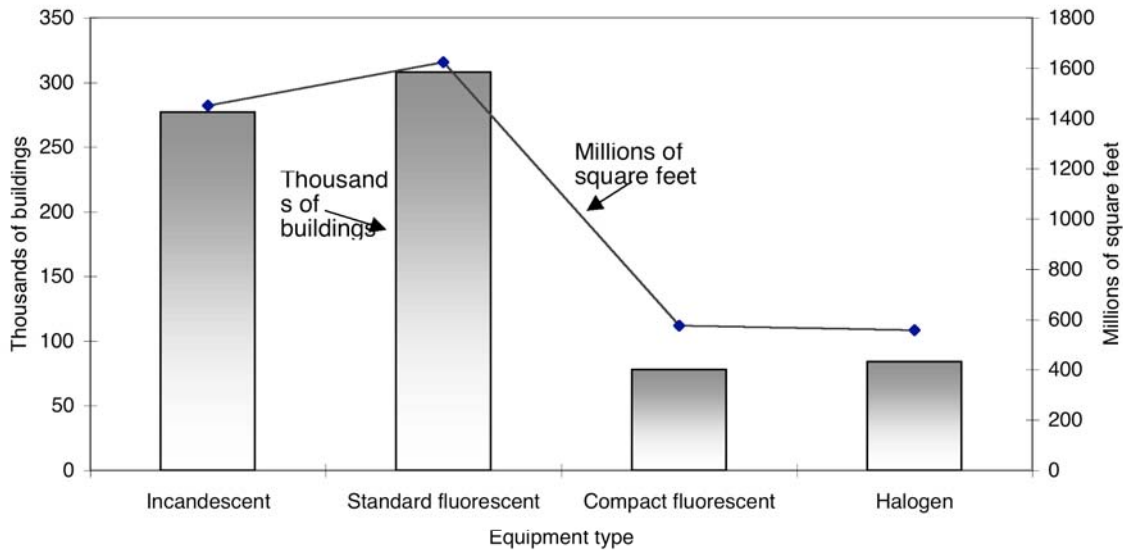
Figure 73 Types of cooling equipment installed in the food services sub-market

Lighting equipment

The majority of buildings have standard fluorescents (79 percent) and incandescent fixtures (88 percent). Buildings accounting for 78 and 88 percent of the total floor space in the sub-market have standard fluorescents and incandescent fixtures, respectively. CFLs and halogen lighting are found in 22 to 24 percent of the establishments, respectively, but these technologies are found in buildings with about 30 percent of the floor space. This suggests that these technologies are being installed in larger buildings. Incandescent and halogen lighting may be used for creating atmosphere, especially in the independent restaurant chains. The development of efficient lighting technologies that can be used to create atmosphere may find ready acceptance by designers for use in restaurants.

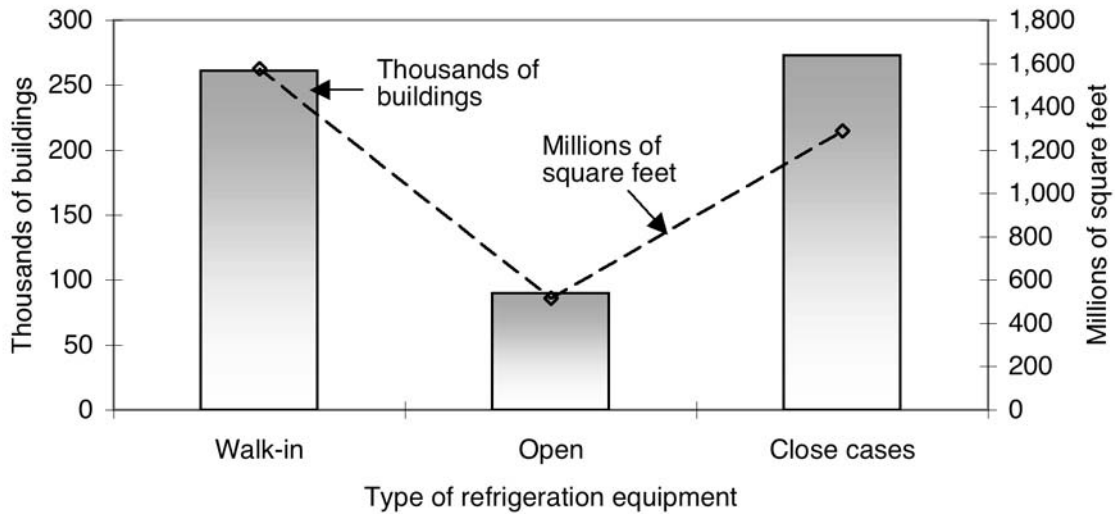
Refrigeration

Not surprisingly, refrigeration equipment is found in 96 percent of food services establishments and in food services establishments accounting for 96 percent of the floor space. Closed cases predominate (75 percent of establishments) but walk-in refrigerators are found in nearly as many establishments (78 percent). Open refrigeration cases are found in about 26 percent of businesses.



Source: EIA, CBECS 1999 Tables B39

Figure 74 Types of lighting installed in the food services sub-market



Source: EIA, CBECS 1999 Tables B36

Figure 75 Types of refrigeration equipment in the food services sub-market

Water heating

Ninety-eight percent of all the buildings involved in food services and sales have some type of water heating. Most of these buildings use central water heating systems (87 percent).

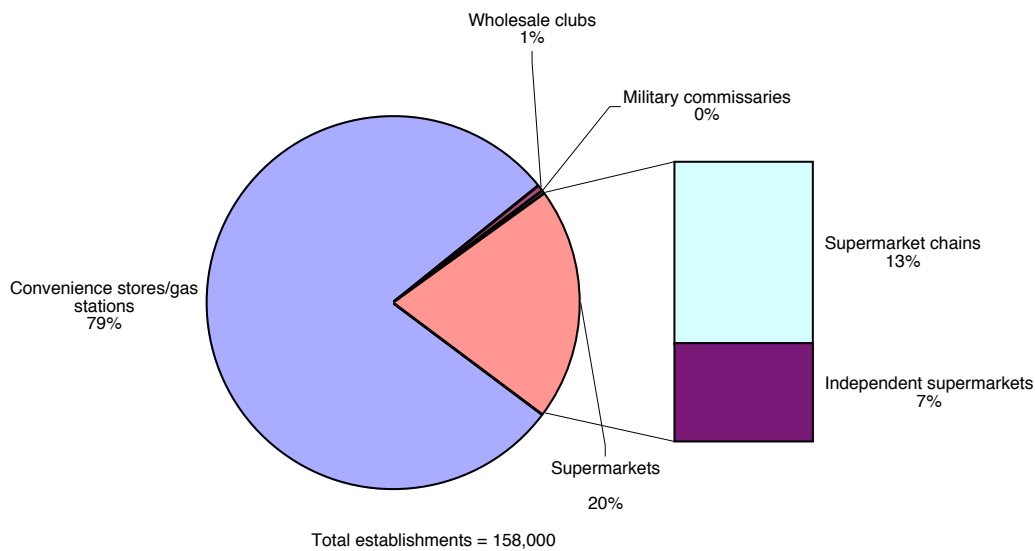
Efficiency measures

CBECS data also provide some insight into the use of energy efficient measures. Electronic ballasts are found in food services establishments accounting for 54 percent of total food services floor space. The equivalent percentages for variable air volume systems,

specular reflectors, and energy management systems are 26, 20, and 12 percent respectively. These percentages are not as high as other types of commercial buildings – for instance, offices.

Food sales

The food sales sub-market can be broken into four categories: grocery stores, wholesale clubs, military commissaries, and convenience stores/gas stations. In terms of the number of establishments, convenience stores are clearly the most numerous, supermarkets the next most numerous, with wholesale clubs and military commissaries the least. Together, there are about 158,000 establishments.



Source: Progressive Grocer: 69th Annual Report of the Grocery Industry – April 2002, pg. 09

Figure 76 Establishments in the food sales sub-market

The picture changes somewhat if one examines sales. Total grocery sales were about \$682 billion in 2001. As we shall see, convenience store sales in 2002 were a little over \$200 billion, of which only about six percent was food sales, and much of this was coffee. As we saw earlier, the wholesale clubs, Costco, Sam's, and BJ's, have sales of about \$60 billion. Based on the data in Table 33, the food sales for these three organizations is about \$41 billion. We do not have a value for military commissaries. When wholesale clubs are excluded, supermarkets have the largest market share of food sales and wholesale clubs are making significant inroads.

Supermarkets

According to U.S. Department of Commerce figures and industry estimates, total sales in U.S. grocery stores in 2001 were \$682.3 billion. Table 33 lists the top 75 players in the supermarket industry. These top 75 players had sales of \$518.9 billion for 76 percent of

Table 33 Top 75 U.S. supermarkets in terms of grocery sales (total U.S. grocery sales – \$682.3 billion)

Rank	Company	Headquarters location	Top executive	Title	Stores owned	Sales in \$bil- lions	Actual or estimated	Date of fiscal year	Percent total of US Sales (682.3)	Comments
1	Wal-Mart Supercenters	Bentonville, AR	Doug Degn	EVP, Food and Merchandise	1,060	65.3	E	1/31/02	9.60	Supercenter sales represent approximately 30% of total corporate sales, which were \$217.8 billion for 2001. Elsewhere, we note that food sales are about 30 percent of Supercenter sales. Thus, it is possible that Wal-Mart should be 7 th or 8 th in this list.
2	Kroger Co.	Cincinnati, OH	Joseph A. Pichler	Chairman, CEO	2,392	50.1	A	2/2/02	7.30	
3	Albertson's	Boise, ID	Lawrence Johnston	Chairman, CEO	2,541	37.9	A	2/1/02	5.60	
4	Safeway	Pleasanton, CA	Steve Burd	Chairman, President, CEO	1,759	34.3	A	12/29/01	5.00	
5	Ahold USA Retail	Chantilly, VA	Bill Grize	President, CEO	1,600	23.2	A	12/31/01	3.40	Ahold USA was split into separate retail and foodservice divisions in September 2001, which combined for sales of \$35.3 billion. Ahold USA accounts for approximately 59 percent of the parent company's 2001 sales of \$59.4 billion, with retail accounting for 39% of the total and foodservice for 20 percent.
6	Supervalu	Minneapolis, MN	Jeff Noddle	President, CEO	463	21.3	E	2/23/02	3.10	Corporate stores at Supervalu account for approximately 43% of total sales. Corporate stores include 262 supermarkets and 201 Save-A-Lot limited assortment stores; the company also licenses 739 Save-A-Lot units.

Rank	Company	Headquarters location	Top executive	Title	Stores owned	Sales in \$bil-	Actual or estimated	Date of fiscal year	Percent total of US Sales (682.3)	Comments
7	Costco Wholesale Corp.	Issaquah, WA	Jim Sinegal	President, CEO	369	20.5	E	9/2/01	3.00	Sales total includes food and sundries only, which accounted for approximately 60% of Costco's \$34.1 billion sales.
8	Sam's Clubs	Bentonville, AR	Tom Grimm	President, CEO	500	18.4	E	1/31/01	2.70	Sales total includes food and sundries only, which accounted for 63 percent of Sam's sales. Sales at Sam's Clubs, including 500 U.S. locations and 65 overseas units, were estimated at \$29.2 billion for 2001, or approximately 13% of Wal-Mart's estimated 2001 volume of \$221 billion.
9	Fleming	Dallas, TX	Mark S. Hansen	Chairman, CEO	116	15.6	A	12/29/01	2.30	Fleming is a major supplier of Super Kmart and also supplies 51 of Super Target's 62 stores, and volume from those companies is reflected in the sales totals for Fleming and for each of the individual retailers. Corporate stores at Fleming account for approximately 12% of sales.
10	Publix Super Markets	Lakeland, FL	Charles Jenkins	Chairman	684	15.1	E	12/29/01	2.20	
11	Delhaize America	Salisbury, NC	Pierre-Olivier Beckers	Chairman	1,461	14.9	A	12/29/01	2.20	Delhaize America, the U.S. division of Brussels-based Delhaize Group, encompasses 1,207 Food Lion stores, 139 Kash 'n Karry units and 115 Hannaford Bros. stores. Delhaize America accounts for approximately 80% of Delhaize Group's estimated 2001 sales of \$19 billion.

Rank	Company	Headquarters location	Top executive	Title	Stores owned	Sales in \$bil- estimated or lions	Date of fiscal year	Percent total of US Sales (682.3)	Comments
12	Loblaw Cos.	Toronto, Canada	Galen Weston	Chairman	1,076	14.6 (\$U.S.)	E 12/29/01	0	Loblaw operates 631 corporate stores and franchises 445 stores.
13	Winn-Dixie	Jacksonville, FL	A. Dano Davis	Chairman	1,153	13.0	E 6/26/02	1.90	
14	A&P	Montvale, NJ	Christian Haub	Chairman, President, CEO	797	11.0	A 2/23/02	1.60	A&P operates 730 corporate stores and 67 franchised units.
15	Meijer, Inc.	Grand Rapids, MI	Doug & Hank Meijer	Co-Chairmen	152	10.6	E 2/2/02	1.60	
16	7-Eleven	Dallas, TX	Jim Keyes	President, CEO	5,800	9.8	A 12/31/01	1.40	7-Eleven operates 5,800 stores in North America, including 5,302 in the U.S. and 498 in Canada, about half of which are corporate and half franchised. Later we list 7-Eleven as a convenience store.
17	H. E. Butt Grocery Co.	San Antonio, TX	Charles C. Butt	Chairman, CEO	295	9.0	A 10/28/01	1.30	H.E.B. sales include volume from 17 stores in Mexico.
18	C&S Wholesale Grocers	Brattleboro, VT	Rick Cohen	Chairman, CEO	0	8.5	E 12/29/01	1.20	C&S supplies products to a variety of the top 75 retailers, including A&P, Ahold USA Retail, Big Y Markets, Pathmark Stores, Safeway and Shaw's Supermarkets, and volume from those companies is reflected in the sales totals for C&S and for each of the individual retailers. C&S volume does not include sales from GU Markets, an affiliate of C&S that operates 30 former Grand Union locations.
19	Sobeys	Stellarton, Nova Scotia	Bill McEwan	President, CEO	1,331	7.6 (\$U.S.)	E 5/4/02	0	Sobeys operates 466 corporate stores (281 supermarkets, 120

Rank	Company	Headquarters location	Top executive	Title	Stores owned	Sales in \$bil-	Actual or estimated	Date of fiscal year	Percent total of US Sales (682.3)	Comments
20	Wakefern Food Corp.	Elizabeth, NJ	Thomas Infusino	Chairman	20	5.9	A	9/29/01	0.90	convenience stores and 65 drugstores) and 865 franchised stores. Approximately 20% of Sobeys' sales come from food-service operations. Wakefern supplies products to three other of the top 75 companies, Big V Supermarkets, Village Super Market and In-serra Supermarkets, and volume from those companies is reflected in the sales totals for Wakefern and for each of the individual retailers. Corporate stores at Wakefern account for less than 1% of total sales.
21	Super Kmart	Troy, MI	Hector Dominguez	Senior VP, Supercenters	125	5.1	E	1/31/02	0.70	Food sales at Super Kmart (encompassing groceries, consumables and restaurants) account for approximately \$1.8 billion, or about 35% of total sales. Super Kmart sales represent approximately 15% of Kmart Corp.'s total sales, which are estimated at \$33.5 billion for 2001.
22	Giant Eagle	Pittsburgh, PA	David Shapira	Chairman, CEO	216	4.5	E	6/30/02	0.70	Giant Eagle operates 136 corporate stores and 80 independent (franchised) stores.
23	Shaw's Supermarkets	East Bridgewater, MA	Ross McLaren	President, CEO	185	4.3	E	3/2/02	0.60	Shaw's is a division of J. Sainsbury PLC, London.
24	Nash Finch Co.	Minneapolis, MN	Ron Marshall	President, CEO	111	4.1	A	12/29/01	0.60	Corporate stores at Nash Finch account for 25% of total sales.
25	Pathmark	Carteret, NJ	James Don-	Chairman,	141	4.0	A	2/2/02	0.60	

Rank	Company	Headquarters location	Top executive	Title	Stores owned	Sales in \$bil-	Actual or estimated	Date of fiscal year	Percent total of US Sales (682.3)	Comments
			ald	President, CEO						
26	Hy-Vee Food	Des Moines, IA	Ron Pearson	Chairman, CEO, COO	215	3.8	A	9/30/01	0.60	Hy-Vee operates 187 supermarkets and 28 drugstores.
27	Spartan	Grand Rapids, MI	James B. Meyer	Chairman, President, CEO	127	3.5	E	3/31/02	0.50	Spartan's corporate stores include 102 supermarkets and 25 deep-discount drugstores. Corporate stores account for 40% of sales.
28	Aldi	Batavia, IL	Charles Youngstrom	President	601	3.5	E	12/31/01	0.50	
29	Roundy's	Pewaukee, WI	Gerald Les-tina	President, CEO	62	3.4	A	12/31/01	0.50	Corporate stores at Roundy's account for 42% of sales.
30	Associated Wholesale Gro-cers	Kansas City, KS	Gary A. Phillips	President, CEO	33	3.1	E	12/28/01	0.50	Corporate stores at Associated Wholesale Grocers account for 5% of sales.
31	BJ' s Wholesale Club	Natick, MA	Jack Nugent	President, CEO	131	3.1	E	2/2/02	0.50	Sales total includes food and sundries only, which account for approximately 60% of BJ's total 2001 sales of \$5.2 billion.
32	Metro	Montreal, Canada	Pierre Les-sard	President, CEO	130	3.1 (\$U.S.)	A	9/29/01	0	Metro operates 82 corporate stores and 48 franchised stores. Corporate stores at Metro account for 33% of total sales.
33	Unified Western Grocers	Los Angeles, CA	Al Plamann	President, CEO	14	3.0	A	9/29/01	0.40	Corporate stores at Unified Western Grocers account for 5% of total sales.
34	Raley's Super-markets	Sacramento, CA	Michael J. Teel	President, CEO	149	3.0	E	6/29/02	0.40	
35	Wegmans Food Markets	Rochester, NY	Robert Wegman	Chairman	62	2.9	E	12/31/01	0.40	
36	Super Target	Minneapolis, MN	Robert J. Ulrich	Chairman, CEO	62	2.7	E	2/2/02	0.40	Super Target sales represent approximately 7% of Target Corp.'s total sales, which were

Rank	Company	Headquarters location	Top executive	Title	Stores owned	Sales in \$bil-	Actual or estimated	Date of fiscal year	Percent total of US Sales (682.3)	Comments
37	Stater Bros. Markets	Colton, CA	Jack Brown	Chairman, President, CEO	155	2.6	A	9/30/01	0.40	estimated at \$39 billion for 2001.
38	Marsh Supermarkets	Indianapolis, IN	Donald E. Marsh	Chairman, CEO	304	2.5	E	3/31/02	0.40	
39	Penn Traffic Co.	Syracuse, NY	Joseph V. Fisher	President, CEO	219	2.4	A	2/2/02	0.40	Marsh Supermarkets operates 111 supermarkets and 193 convenience stores.
40	Harris Teeter	Matthews, NC	Fred Morganthall	President	137	2.4	A	9/30/01	0.40	
41	Whole Foods Market	Austin, TX	John Mackey	Chairman, President, CEO	126	2.3	A	9/30/01	0.30	Schnuck Markets
42	Schnuck Markets	St. Louis, MO	Craig Schnuck	Chairman, CEO	91	2.1	E	9/30/01	0.30	
43	Weis Markets	Sunbury, PA	Robert F. Weis	Chairman	163	2.0	A	12/29/01	0.30	Price Chopper
44	Price Chopper	Schenectady, NY	Lewis Golub	Chairman	102	2.0	E	4/28/02	0.30	
45	Ingles Markets	Black Mountain, NC	Robert P. Ingle	Chairman, CEO	203	2.0	A	9/29/01	0.30	Sales at Alex Lee, Inc., include \$925 million from Lowes Food Stores, Winston-Salem, NC, \$1.3 billion from Merchants Distributors, Inc., Hickory, NC, a wholesaler (approximately 45% of whose sales go to Lowes), and \$263 million from Institution Food House, Hickory, NC, a foodservice distributor.
46	Alex Lee, Inc.	Hickory, NC	Boyd George	Chairman, CEO	101	1.9	A	9/29/01	0.30	
47	Demoulas Mar-	Tewksbury,	William J.	Chairman	58	1.8	E	12/29/01	0.30	

Rank	Company	Headquarters location	Top executive	Title	Stores owned	Sales in \$bil- Actual or estimated lions	Date of fiscal year	Percent total of US Sales (682.3)	Comments
48	ket Basket Federated Co-operatives	MA Saskatoon, Saskatchewan	Shea Dennis Banda	Chairman, President	8	1.7 (\$U.S.)	E 10/27/01	0	
49	Overwaitea Food Group	Langley, British Columbia	Steve Vanderleest	President	116	1.7 (\$U.S.)	E 12/31/01	0	
50	White Rose Foods	Somerset, NJ	Stephen Bokser & Richad Neff	Co-CEO	0	1.6	E 12/29/01	0.20	
51	Save Mart Supermarkets	Modesto, CA	Robert M. Piccinini	Chairman, President, CEO	96	1.6	E 12/31/01	0.20	
52	Brookshire Grocery Co.	Tyler, TX	Bruce Brookshire	Chairman	137	1.6	E 9/29/01	0.20	
53	Purity Wholesale Grocers	Boca Raton, FL	Sal Ricciardi	President, CEO	0	1.6	E 6/30/02	0.20	
54	Smart & Final	Los Angeles, CA	Ross Roeder	Chairman, CEO	232	1.5	A 12/31/01	0.20	Smart & Final sales include approximately 21% from foodservice operations.
55	WinCo Foods	Boise, ID	William D. Long	Chairman, CEO	36	1.5	E 3/30/02	0.20	
56	Grocers Supply Co.	Houston, TX	Max & Milton Levit	Co-CEO	0	1.4	E 12/31/01	0.20	
57	Associated Food	Salt Lake City, UT	Richard Parkinson	President, CEO	22	1.3	E 3/30/02	0.20	Corporate sales at Associated Food Stores account for 25% of total sales.
58	Bashas'	Chandler, AZ	Eddie N. Basha Jr.	Chairman, CEO	128	1.3	E 12/31/01	0.20	Bashas' sales totals include 22 stores acquired in November from Southwest Supermarkets, Phoenix, AZ.
59	Big Y Markets	Springfield, MA	Donald D'Amour	Chairman, CEO	46	1.2	E 6/30/02	0.20	
60	Minyard Food	Coppell, TX	Gretchen Minyard Williams, Liz	Co-Chairs, Co-CEOs	73	1.0	E 6/30/02	0.10	Minyard sales include volume from 14 gas stations.

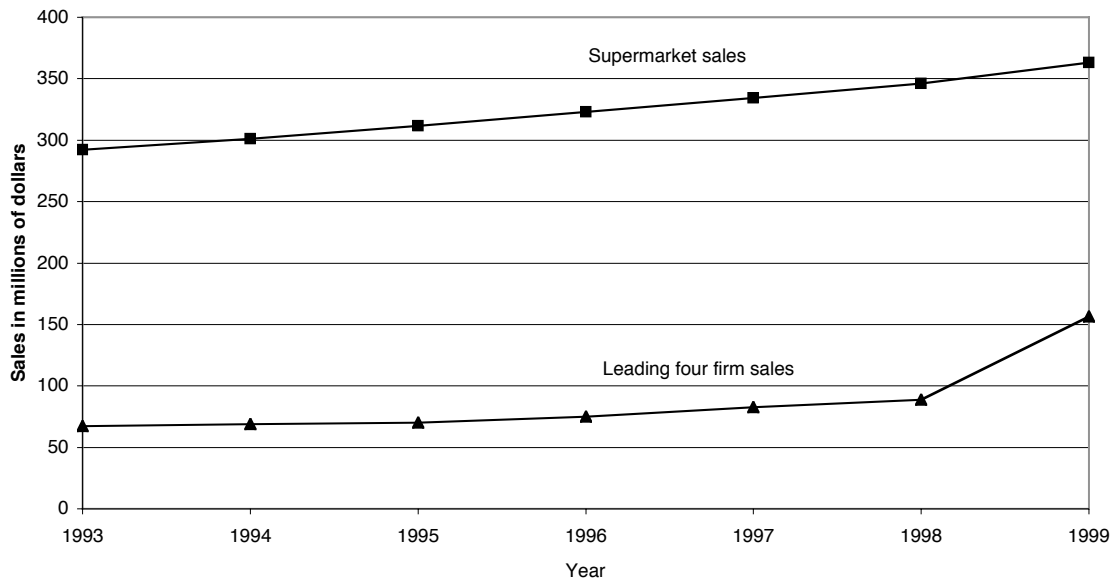
Rank	Company	Headquarters location	Top executive	Title	Stores owned	Sales in \$bil-	Actual or estimated	Date of fiscal year	Percent total of US Sales (682.3)	Comments
61	K-VA-T Food	Abingdon, VA	Jack Smith	Chairman	86	1.0	E	12/31/01	0.10	
62	Associated Wholesalers, Inc.	Robesonia, PA	J. Chris Michael	President, CEO	9	1.0	E	7/31/02	0.10	Corporate stores at AWI account for 6% of total sales.
63	Associated Grocers	Seattle, WA	Robert P. Hermanns	President, CEO	1	0.9	A	9/29/01	0.10	
64	Foodarama	Freehold, NJ	Joseph Saker	Chairman, CEO	22	0.9	A	11/3/01	0.10	
65	Fiesta Mart	Houston, TX	Louis Kapitodis	President, CEO	43	0.9	E	5/26/02	0.10	
66	Wild Oats Markets	Boulder, CO	Perry Odak	President, CEO	109	0.8	A	12/29/01	0.10	
67	Bozzuto's	Cheshire, CT	Adam Bozzuto	Chairman	10	0.8	A	9/29/01	0.10	Corporate stores at Bozzuto's account for 6% of total sales.
68	Inserra Supermarkets	Mahwah, NJ	Lawrence R. Inserra	Chairman, CEO	21	0.8	A	12/29/01	0.10	
69	Big V Supermarkets	Florida, NY	James Toopes	President, CEO	31	0.8	E	12/29/01	0.10	Big V has signed a preliminary agreement with Wakefern Food Corp. that could lead to its acquisition by the supplier.
70	Village Super Market	Springfield, NJ	James Sumas	Chairman	23	0.8	A	7/28/01	0.10	
71	King Kullen Grocery Co.	Bethpage, NY	John B. Cullum & Bernard D. Kennedy	Co-chairmen, Co-CEOs	45	0.7	E	9/29/01	0.10	
72	Brookshire Brothers	Lufkin, TX	Tim Hale	President, CEO	71	0.7	E	4/27/02	0.10	
73	Eagle Food Centers	Milan, IL	Jeffrey L. Little	President, CEO	64	0.7	E	2/2/02	0.10	
74	Haggen, Inc.	Bellingham, WA	Dale C. Henley	President, CEO	28	0.7	E	12/29/01	0.10	
75	Certified Gro-	Hodgkins, IL	James E.	President	0	0.7	E	8/31/01	0.10	

Rank	Company	Headquarters location	Top executive	Title	Stores owned	Sales in \$bil-	Actual or estimated	Date of fiscal year	Percent total of US Sales (682.3)	Comments
	cers Midwest Totals		Bradley			518.9				

the \$682 billion in annual grocery sales. Among them, these players have more than 29,000 stores. Depending on how Wal-Mart's Supercenter sales are counted, the top five players account for \$210.3 billion (31 percent) of supermarket sales.¹⁴¹ The top 15 players capture 50 percent of the sales. The smallest of the top 75 players have sales of about \$700 million annually. What these numbers demonstrate is a high degree of concentration among a relatively small number of firms in the grocery industry.

In the late 1990s, there was a wave of supermarket mega-mergers that led to an increase in the national supermarket four-firm concentration level to 43 percent in 1999. Figure 77 shows historical supermarket sales and sales attributed to the four leading firms from 1993 to 1999. Notice that the sales total is for a selected group of supermarkets and not the total for national grocery sales as identified above. As an example of the mergers:

- Kroger purchased the Fred Meyer chain, the Texas division of Winn-Dixie, and Pay Less Supermarkets, adding more than \$15.1 billion in sales to its share.
- Albertson's purchased the fifth largest retailer in 1997, American Stores, with sales of \$19.9 billion.
- Safeway purchased Randall's Food Markets, Carr-Gottstein, and Dominick's. These mergers account for the huge jump in national supermarket concentration. (Franklin, 2000)



Sources: Census of Retail Trade, company annual reports. The total supermarket sales are based on a subset of the companies listed in Table 33 and thus do not total \$682 billion. Even so, the level of concentration is still dramatic.

Figure 77 Historical sales for selected supermarkets

¹⁴¹ As noted below, some proportion of Supercenter sales are non-food items. Unfortunately, food and non-food item sales appear not to be separated in Table 33. Also, the data in Table 33 are more recent than those cited in the text below. Supercenter food item sales are likely to be at least \$18 to 20 billion and perhaps more suggesting that Wal-Mart is probably seventh or eighth in the list.

In addition, Wal-Mart has expanded rapidly into the grocery business. Lewis (1999) notes that Wal-Mart gives other retailers significant competition for consumers as it continues to open more stores across the country. According to Rich Parkinson, CEO of Associated Food Stores:

One of the biggest challenges is seeing how the independent sector will compete with the five entities (Wal-Mart, Kroger, Albertson's, Safeway, and Ahold) that control more than 40% of the industry's volume, in terms of relationships with their suppliers. There's no question what impact Wal-Mart's relationship with suppliers has had ... what will that mean to vendors and what consequences will it have for independent channels?"¹⁴²

Wal-Mart's growth has been achieved through capital investment in building new or remodeling existing Wal-Mart stores with the Supercenter format that includes both general merchandising and full-size supermarket areas. Currently, there are more than 720 Wal-Mart Supercenters. Wal-Mart opened 275 new Supercenters during 1998 and 1999, and will continue to increase the number of Supercenters to over 1,400 by the year 2005. Most remodeling has been in smaller cities and rural areas that tend to have less organized labor markets.¹⁴³ These Supercenters will affect the concentration of food retailers.

The Supercenter format is why Wal-Mart is at the top of the supermarket group in Table 33. We should note, however, that only a portion of Wal-Mart's sales listed in Table 7 are grocery sales. In 1999, about 30 percent of Supercenter sales were food related items meaning that Wal-Mart sold about \$15 billion. That amount has obviously increased during the interim. Continued capital spending on remodeling and new construction of its Supercenters in the next few years may propel Wal-Mart to become the top grocery retailer in the United States.

David Glass, President and CEO of Wal-Mart said that:

This concept took the idea of retailing both general merchandise and food in the same building and created the convenience of "one-stop shopping." It has become our key domestic growth vehicle and will remain so for at least the next 10 years.¹⁴⁴

According to Ed Comeau, financial analyst at Donaldson Lufkin & Jenrette:

...Wal-Mart hasn't begun to broach the issue of getting into metro markets, capturing large market shares like the Krogers and the Safeways. It's really just taking a step toward picking up a lot of the incremental business along the path of least resistance in the secondary and smaller markets. ... I wouldn't imagine Wal-Mart is a big metromarket threat...."¹⁴⁵

Additionally, David Glass adds:

¹⁴² Zwiebach, 2000b, p. 9, 15

¹⁴³ Andrew Franklin, The Impact of Wal-Mart Supercenter Food Store Sales on Supermarket Concentration in U.S. Metropolitan Areas, Presented at the USDA conference, "The American Consumer and the Changing Structure of the Food System," Arlington, VA., May 3-5, 2000, Food Marketing Policy Center

¹⁴⁴ Wal-Mart Annual Report, 1999

¹⁴⁵ Supermarket News, 1999

Supercenters effectively serve a large trade area, but we think there may be some business that we are not getting purely because they may not be as close to the consumer or convenient for small shopping trips.¹⁴⁶

The full impact of Wal-Mart's expansion will not be felt until it has captured large market shares in large metro areas (*Supermarket News*, 1999). To increase sales in large market areas, Wal-Mart introduced the Neighborhood Market Store in test format. This is a smaller format supermarket designed to get closer to customers. While new supermarkets built today exceed 60,000 to 70,000 square feet, Neighborhood Markets average 40,000 square feet per store and hold a smaller number of items in this much smaller building.

This smaller footprint gives Wal-Mart the flexibility that it needs to acquire the real estate for new stores in dense urban areas. According to Ken Teague, retail consultant at Reach Marketing, the small size would allow Wal-Mart to easily purchase existing store space at the 40,000 square feet size.¹⁴⁷

Supermarket buildings and energy use

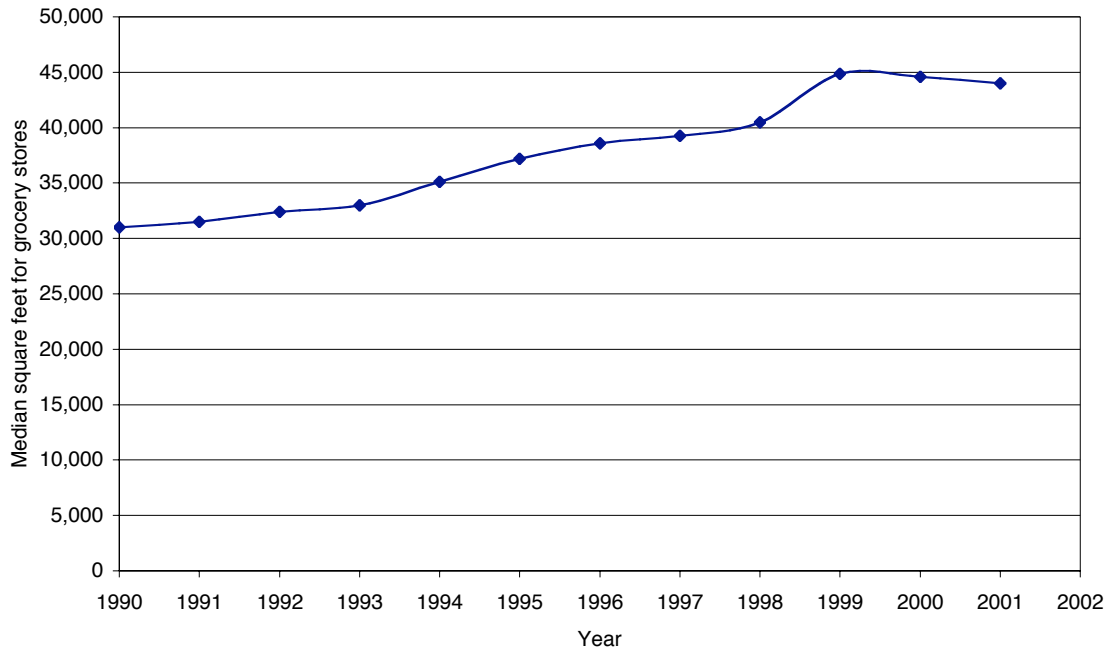
While Wal-Mart is looking for stores with smaller footprints in metropolitan areas, the median size of supermarkets has generally increased over the last 10 years. The median size of grocery stores increased from about 31,000 square feet in 1990 to about 44,000 square feet in 2001. The increase in size appears to have peaked in 1999 and declined slightly by 2001. Whether that is an artifact of who is building grocery stores or signals a shift is unclear.

As we have found in other sub-markets, investment decision-making is highly centralized by corporate management and is heavily supported by an extensive network of in-house engineering, design, and financial resources. Investment decisions are usually driven by the need to increase market share, address "marketing and presentation concerns," and to control operating costs. With respect to energy, national chains typically work through regional energy managers who supervise stores and work closely with the national office.¹⁴⁸

¹⁴⁶ Wal-Mart Annual Report, 1999

¹⁴⁷ Ghitelman, 1999a

¹⁴⁸ Commercial Buildings Initiative Target Market Priorities, Schick Consulting/Pacific Energy Associates, Inc. pg. 22



Source: Food Marketing Industry Speaks 1992–2002

Figure 78 Average square footage of supermarkets

As Table 34 shows, the supermarket industry runs on very thin margins. Profit is three percent of sales and 11 percent of gross margins. Utilities are about one percent of sales and four percent of gross margins. Obviously, labor is a much more significant item, but reducing energy costs can make a difference at the bottom line.

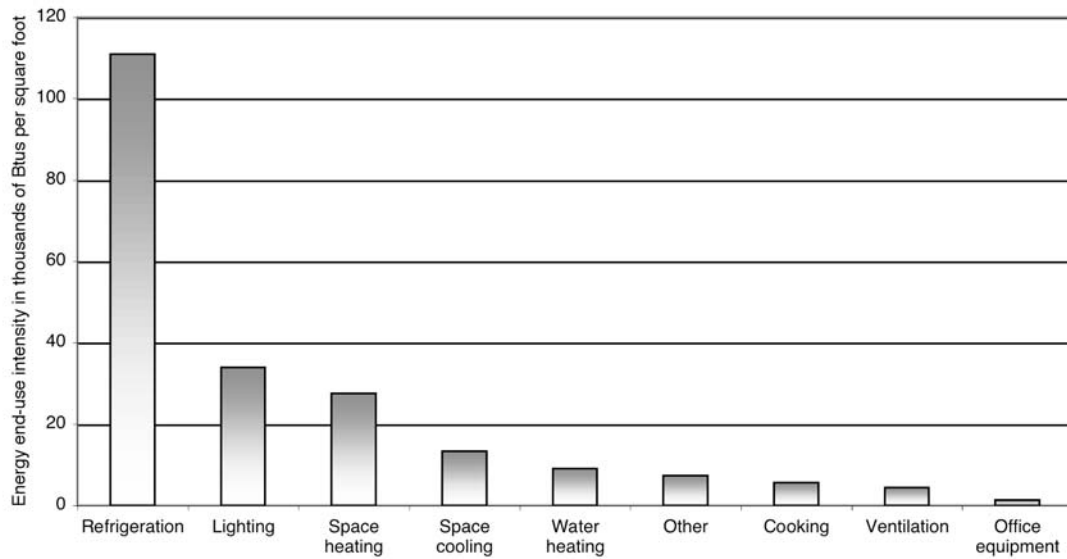
Energy end-use intensities in the food sales sub-market

Not surprisingly, refrigeration is the dominant energy use in the food sales sub-market. In fact, three times as much energy is used for refrigeration as for lighting.

Table 34 Selected supermarket operating costs-2001

Operating costs	Percent of sales	Percent of gross margin
Gross margin	27.7	100.00
Utilities	1.2	4.33
Total expenses	25.5	92.05
Net operating profit (loss)	3.1	11.19
Net other income (expense)	0.2	.72
Net income before tax & extraordinary items	3.3	11.91

Source: FMI Speaks 2002, pg. 14, Key Industry Facts – Prepared by FMI Information Service, June 2002

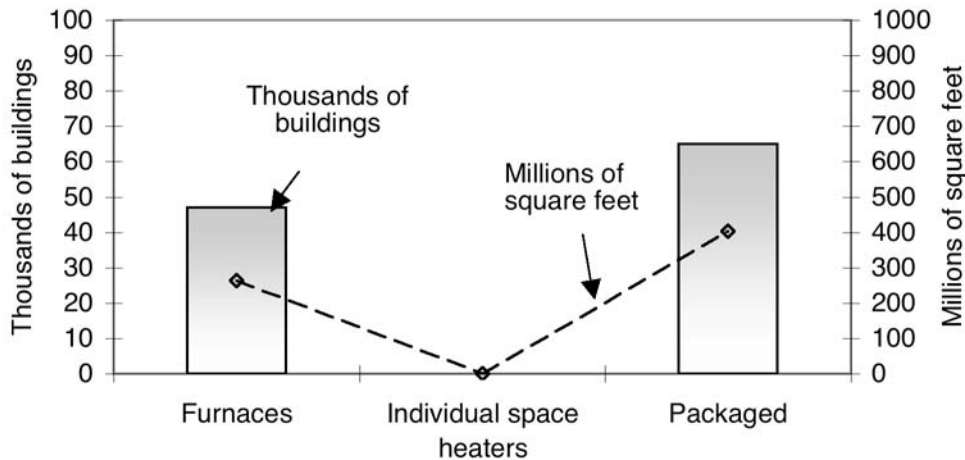


Source: EIA, CBECS 1999 Tables B39

Figure 79 Energy end-uses in the food services sub-market

Energy using and saving equipment in the food sales sub-market

According to CBECS, there are approximately 174,000 food sales establishments and a billion square feet in the food sales sub-market. Slightly more than one-quarter (27 percent) of the establishments have furnaces. Another 37 percent have packaged units. In terms of floor space, about 30 percent and 41 percent of floor space have furnace and packaged units respectively. Estimates for other types of heating are not stable enough to report.



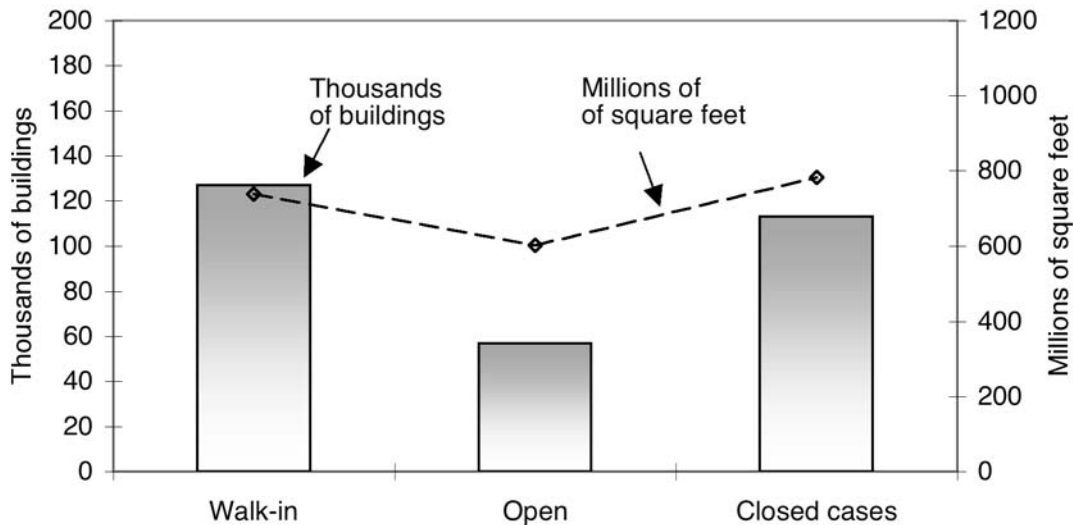
EIA, CBECS 1999 Tables B32-B33

Figure 80 Types of heating equipment in food sales establishments

About 58 percent of the establishments use packaged units for cooling. These establishments represent about 61 percent of floor space. CBECS does not report other types of cooling equipment.

CBECS data indicate that nearly 100 percent of the establishments and establishments accounting for 100 percent of floor space have standard linear fluorescents. Thirty percent of the establishments and establishments accounting for 53 percent of floor space have incandescents. This suggests that incandescents are found in larger establishments. The samples were not large enough to report stable estimates for halogen or compact fluorescent lamps.

In terms of the number of establishments, walk-in refrigeration is most commonly found in establishments (73 percent) compared to closed cases, which are found in fewer than 70 percent of establishments in the food sales sub-market. However, closed-case refrigeration is found in establishments accounting for 79 percent of the total square footage while walk-in cases are slightly less common being found in establishment accounting for 75 percent of the total square footage. Open cases are found in the fewest establishments, 33 percent, although establishments having nearly 60 percent of total floor space have them. Thus, open cases are more likely to be found in the largest establishments.



Source: EIA, CBECS 1999 Tables B37

Figure 81 Types of refrigeration in the food sales sub-market

Using CBECS data, we also briefly examined the penetration of measures that might be related to energy efficiency. As noted above, establishments with nearly 100 percent of the food sales floor space reported having fluorescents. Establishments having 78 percent of total floor space reported at least some lighting with electronic ballasts. This would suggest a fairly high degree of penetration of efficient linear fluorescent lighting in this sub-market.

Buildings representing about 30 percent of the total floor space had energy management systems. Variable air volume systems were found in establishments with about 21 percent of total floor space. Specular reflectors were found in establishments with 18 per-

cent of floor space. Skylights and atriums were found in establishments with about 15 percent of total floor space. With the exception of the efficient linear fluorescent lighting, it does not appear that other efficiency related measures had high penetration in this market.

Convenience stores

Convenience stores have replaced America's corner stores. According to the National Association of Convenience Stores (NACS), there were approximately 132,400 convenience stores in the United States in 2002. The Association defines a convenience store as a store that has more than 500 products with unique SKUs. Nationwide, 2002 sales totaled \$290.6 billion for these stores. Of these sales, \$181.3 billion or 62 percent were for mobility fuels.

According to NACS, the balance of the \$109 billion in sales fall into the product categories shown in Table 35. Food services were about \$13.4 billion. According to NACS, a good percentage of this was coffee service. If tobacco products, general merchandise, and the category of products falling into other are removed, then convenience stores had revenues of about \$47 billion for food and beverages. This is about 16 percent of total revenue for convenience stores.

Table 35 Convenience store percent of sales in product categories exclusive of mobility fuels

Rank	Product category	Percent of 2001 sales	Percent of 2002 sales
1	Cigarettes	38.7	36.0
2	Foodservice	11.4	12.3
3	Packaged beverages (non-alcoholic)	11.7	12.2
4	Beer	9.9	11.0
5	General merchandise	3.6	4.0
6	Candy	3.4	3.9
7	Fluid milk products	3.0	2.8
8	Other tobacco	2.7	2.7
8	Salty snacks	2.3	2.7
10	Packaged sweet snacks	1.8	1.8
	Other	11.5	10.6

Source: NACS, 2003 State of the Industry

Table 36 shows the distribution of the top 50 convenience store operators. It would appear that 55,000 stores or 42 percent are owned or franchised by the top 50 operators. It is unclear what percentage of the properties are franchises. NACS does say that 59 percent of the stores are owned and operated by independent operators. Although we do not have access to the data, NACS implies that the sales in stores owned by the chains are higher than sales in the stores of the independents.

Table 36 Top 50 convenience store operators

2002 Rank	2001 Rank	Company	Number of stores	President/CEO
1	1	7-Eleven Inc., Dallas, TX	5829	Jim Keyes
2	2	Royal Dutch/Shell Group of Companies, The Hague/London	5372	Robert Routs (Shell Oil Products U.S.), John Boles (Motiva Enterprises)
3	39	Phillips Petroleum Co., Bartlesville, OK	4990	James Mulva
4	5	BP PLC, London	4900	Sir John Browne
5	4	Exxon Mobil Corp., Irving, TX	2799	Lee R. Raymond
6	6	Chevron Texaco Corp., San Francisco, CA	2749	David J. O'Reilly
7	8	Speedway SuperAmerica LLC, Enon, OH	2100	Ronald G. Becker
8	10	Alimentation Couche-Tard Inc., Laval, Quebec	1955	Alain Bouchard
9	-	Valero Energy Corp., San Antonio, TX	1942	William Greehey
10	12	FEMSA Comercio S.A. de C.V., Monterrey, Mexico	1779	Eduardo Padilla
11	7	Imperial Oil Co., Toronto, Ontario	1664	Tom Hearn
12	14	Casey's General Stores Inc., Ankeny, IA	1334	Ronald Lamb
13	13	The Pantry Inc., Sanford, NC	1305	Peter Sodini
14	15	Clark Retail Enterprises Inc., Oak Brook, IL	1136	Brandon K. Barnholt
15	16	Amerada Hess Corp., Woodbridge, NJ	1112	John B. Hess
16	19	Cumberland Farms Inc., Canton, MA	873	Lily H. Bentas
17	17	The Kroger Co., Cincinnati, OH	789	Joseph Pichler
18	18	Country Energy LLC, Inver Grove Heights, MO	770	John Johnson
19	23	Sunoco Inc., Philadelphia, PA	652	John G. Drosdick
20	-	SSP Partners Inc., Corpus Christi, TX	642	Sam L. Susser
21	24	Getty Petroleum Marketing Inc., East Meadow, NY	572	Vincent J. DiLaurentis
22	21	Husky Energy Inc., Calgary, Alberta	552	John C. Lau
23	25	Wawa Inc., Wawa, PA	543	Richard D. Wood, Jr.
24	20	Swiftly Serve Corp., Durham, NC	520	Jeff Hamill
25	29	FFP Marketing Co. Inc., Fort Worth, TX	501	John Harvison (CEO), Robert J. Byrnes (President)

2002 Rank	2001 Rank	Company	Number of stores	President/CEO
26 (tie)	27	Kampgrounds of America Inc., Billings, MT	500	Jim D. Rogers
26 (tie)	26	Racetrac Petroleum Inc., Atlanta, GA	500	Carl Bolch Jr.
28	39	Petro-Canada Inc., Calgary, Alberta	495	Norman F. McIntyre
29	9	Shell Canada Products Ltd., Calgary, Alberta	490	Timothy Faithfull
30	22	Dairy Mart Convenience Stores Inc., Hudson, OH	457	Gregory G. Landry
31	28	E-Z Mart Stores Inc., Texarkana, TX	425	Sonja Hubbard
32	32	QuikTrip Corp., Tulsa, OK	388	Chester Cadieux
33	38	United Refining Co. of Pennsylvania Inc., Warren, PA	371	Paul C. Rankin (VP, Retail)
34	39	Kwik Trip Inc., La Crosse, WI	349	Don Zieflow
35	31	Ahold USA Inc., Chantilly, VA	340	William J. Grize
36	36	Holiday Stationstores Inc., Bloomington, MN	322	Ron Erickson
37	34	Stewart's Shops Corp., Saratoga Springs, NY	314	William P. Dake
38	36	Allsup's Convenience Stores Inc., Clovis, NM	310	Lonnie Allsup
39	50	Pilot Corp., Knoxville, TN	307	James Haslam
40	35	Krause Gentle Corp., West Des Moines, IA	306	W. A. Krause
41	33	Convenient Food Mart Inc., Painesville, OH	302	John C. Call
42	44	Sheetz Inc., Altoona, PA	275	Stanton R. Sheetz
43	-	Tesoro Petroleum Corp., San Antonio, TX	260	Bruce Smith
44	43	Warren Equities Inc., Providence, RI	248	Herbert M. Kaplan
45 (tie)	46	Delek Energy Corp., Franklin, TN	236	James Alligood
45 (tie)	42	Uni-Marts Inc., State College, PA	236	Henry D. Sahakian
47	48	Kiel Brothers Oil Co. Inc., Columbus, IN	217	Gregory J. Pence
48	-	Tedeschi Food Shops Inc., Rockland, MA	216	Charles Fitzgibbons
49	50	United Dairy Famers Inc., Norwood, OH	196	Alan Lindner
50	-	Sinclair Oil Corp., Salt Lake City, UT	187	
		Total	55627	

NACS reports that utilities account for about five percent of convenience store costs. The major energy uses are likely to be for lighting, pumps, and compressors.

We included convenience stores in the food sales category. While convenience stores sell food, mobility fuels and other products account for 84 percent of the revenue. In terms of categorizing them, convenience stores are a category of their own that should fall under general retail.

Before leaving convenience stores, we should note that once again we see a concentrated pattern of ownership and franchising. There are also a large number of independents. Encouraging energy efficiency in this sub-market will require both a national level strategy as well as regional and local strategies.

Summary and conclusions for food sales and services

This chapter describes the food sale and service market. There are five general types of businesses: growers and producers, food processing, wholesalers, food sales, and food services. There is some vertical integration among the businesses, especially between growers and producers and between wholesalers and food sales. The focus in this report is mostly on the wholesalers, food sales, and food service.

In the last forty years, the number of food services firms (as opposed to establishments) has increased somewhat dramatically. The number of processing and retailing firms has declined and the number of wholesalers has remained fairly constant.

Food processing

The food processing and beverage industry comprise approximately one-sixth of the U.S. manufacturing sector's activity. There is a fair degree of concentration in this industry. In 1998, the total sales for top 50 food and beverage companies was about \$250 billion.

Food wholesaling

Food wholesaling can be subdivided into three groups: merchant wholesalers, agents and brokers, and manufacturers selling direct. Merchant wholesalers account for a bit more than half of the \$589 billion in annual sales of wholesalers with the agents and brokers comprising about a fifth and manufacturers about one-quarter. Merchant wholesalers can be further divided into broad line distributors, specialty wholesalers, and miscellaneous wholesalers. Broad line wholesalers are being challenged by the large grocery chains and are responding by diversifying into that market. There is a fair bit of concentration occurring in the broad line market. The top four firms in the broad line market increased their market share from 26 to 41 percent between 1987 and 1997 mostly at the expense of firms in the bottom part of the top 50.

Two large distributors, Sysco Corporation and U.S. Food Service, account for \$39 billion of the \$52 billion of sales by the top 10 vendors in the institutional market.

Food services

The number of restaurants has doubled to 858,000 in the last 30 years. Forty-three percent of restaurants are fast-food outlets, essentially chains and franchises. Thirty-nine percent are independent restaurants and lunchrooms.

The typical person over the age of eight eats 218 meals away from home annually. In addition, an increasing number of consumers are utilizing takeout. U.S. households now average one takeout meal per month. Grocery stores, in particular, are capitalizing on the trend toward takeout. As we noted earlier, these trends suggest that:

- Eating out will continue to increase meaning that the expansion of food establishments will increase.
- Take-out will increase which may result in changes in the types of buildings being used as food establishments. Takeout establishments may become smaller and may be located in areas with good road access to residential neighborhoods.
- Eating out and takeout may increase household energy use in terms of mobility fuels and change internal household energy use patterns.

The top 25 food services chains with their 62 brands account for one-third of commercial food services sales and more than three-quarters (78 percent) of fast-food sales in this country. Within brands, the chain may own anywhere from 0 to 100 percent of the establishments. The median percent of chain-owned establishments for the top 25 food services chains is 23 percent. For the major food services chains, there are a relatively small number of decision makers who make decisions about equipment and set standards for a large number of establishments. The degree to which energy efficiency is currently addressed by the large chains is unclear. That is an issue for another study. These decisions carry over to franchisees through architectural services, planning, training, and quality control. It is clear that these organizations are probably best addressed at a national or regional level.

Cooking is the largest end-use. Energy use for cooking is bound up with a host of issues including taste, food quality, health issues, labor requirements, etc. There are a broad range of interest groups focused on influencing these issues especially with respect to fast-food and takeout operations. The tradeoffs among these issues are likely to significantly influence energy use. Ultimately, chains are likely to deal with these issues through architectural designs and standards.

There may be substantial energy efficiency potential for integrating heat from cooking and refrigeration with water and space heating requirements. In 1999, the use of energy management systems did not appear to have penetrated more than 25 percent of total floor space of food services establishments. Also in 1999, about half of the establishments as represented by floor space appeared to have efficient linear fluorescent lighting. The use of incandescent lamps also appears to be widespread. Lighting that is both efficient and designed to provide mood and atmosphere might be of special interest in the independent part of the food services sector. Thus, there appears to be room for energy efficiency improvements in the food services sub-market at a number of levels.

There are a large number of smaller independent restaurants and lunchrooms. These are regionally and locally owned and operated. Potentially, these establishments might benefit particularly from technology-specific efficiency improvements as well as holistic and/or integrated equipment solutions. However, these organizations may have to be addressed on an establishment-by-establishment basis. There may be general solutions that can be designed with regional and national resources but these solutions will have to be delivered to local establishments and their contractors through local and regional organizations.

Energy costs are a small percentage of overall costs but can substantially impact the overall profitability of food service operations especially the smaller independent operations.

Food sales

There are 158,000 food sales establishments in the U.S. Nearly 79 percent are convenience stores and gas stations, 20 percent are supermarkets, and one percent is wholesale clubs and military commissaries.

There is a high degree of concentration in the supermarket industry. The top 75 grocers sell 76 percent (\$519 billion) of the groceries sold in the U.S. annually. If Wal-Mart is included, the top five firms account for nearly 40 percent of those groceries. With this degree of concentration, decision-making with respect to facilities is heavily influenced by a relatively small number of national and regional managers. Investment decisions are usually driven by the need to increase market share, address marketing and presentation concerns, and to control operating costs.

Not surprisingly, refrigeration is the dominant energy use in the food sales sub-market. Three times as much energy is used for refrigeration as for lighting. In terms of square footage, closed-case refrigeration is found in the establishments representing the most square feet. It is closely followed by walk-in cases and then open cases. Open cases tend to be found in the largest stores.

There are 132,000 convenience stores in the U.S. The sales in convenience stores (\$291 billion) are less than half of those for food sales establishments. About 16 percent of the sales in convenience stores are for food and beverages.

Once again we see a high degree of concentration in this industry. The top 50 operators own or franchise 42 percent of all convenience stores. The level of control varies from strict control with specific standards to a fairly loose association of stores.

The bottom line

The changing demands of American consumers, notably the increased demand for time saving meals and meal preparation, have influenced the direction of this diverse market group. Four major trends in the food industry are significantly altering its market structure and scope.

- There is an ongoing consolidation of market players.

- There are increased mergers and acquisitions in several parts of the market including wholesaling.
- Supermarket chains are growing and increasing their market share. Wal-Mart is significantly impacting the food sales market.
- There is rapid growth in restaurant chains.
- There is a changing customer demographic that is fueling the demand for convenience dining including dining out and takeout.
- Nontraditional providers are entering the market.
 - There is the emergence of the Wal-Mart supercenters.
 - Wholesale clubs such as Costco and Sam's are growing.
 - E-commerce in grocery delivery and meal takeout is beginning to take hold.
- Capital and operating costs are rising.
 - Margins are relatively thin in parts of this market and increases in energy costs can result in a reduction in profits.
 - The cost of constructing new facilities is increasing.

In all parts of the food sales and services market, we have noted high degrees of concentration in ownership and/or franchising. For many of the players, this means centralized decision-making at the national or regional level and/or the use of standards and guidelines in building new facilities. For these players, commitments to energy efficiency will need to be made at high levels.

There are also many small independent players in these markets. These players will need to be approached on a one-to-one basis. For these players it will be important to leverage local resources such as contractors. It will also be important to provide information and tools that these players can use.

Chapter 8 The Lodging Sub-Market

Introduction

The travel and tourism industry is currently the third largest retail industry in the U.S. behind automotive and food stores. Travel and tourism is the nation's largest services export industry and one of America's largest employers. In 29 states, the tourism industry is either the second or third largest employer. The tourism industry includes more than 15 interrelated businesses including lodging, airlines, cruise lines, car rental firms, travel agents, and tour operators. Many sub-markets within the travel and tourism industry – airlines, cruise lines, car rental agencies, travel agents, and tour operators – own or rent office and retail space. However, the lodging industry is different in that it constructs specialized buildings and derives its revenues from the operation of those facilities. This chapter characterizes the lodging industry in some detail.

Size and scope

The lodging segment is one of the smallest commercial building sub-markets, accounting for approximately 175,000 buildings and four billion square feet of commercial floor space. The 175,000 buildings are found at 53,000 properties with more than 4.2 million rooms. According to Smith Travel Research, there are 41,963 properties and 4.2 million rooms at properties with more than 15 rooms. In 2001, this sub-market had \$103.6 billion in sales and \$16.1 billion in pre-tax profits. The general economics of lodging appear to be such that larger and more luxurious hotel and economy chains are thriving while mid-priced family-oriented chains are being squeezed.

A recent Smith Travel Research Study found that most hotels in the United States are small independent properties although many of these are franchise operations affiliated with national chains. More than three-quarters (85 percent) of all lodging properties in the United States have fewer than 150 rooms. Slightly more than half of the properties (52 percent) have fewer than 75 rooms. Forty-five percent of the properties charge less than \$60 a night.

Segments within the market

The lodging industry tends to think of itself in terms of three segmentation criteria:

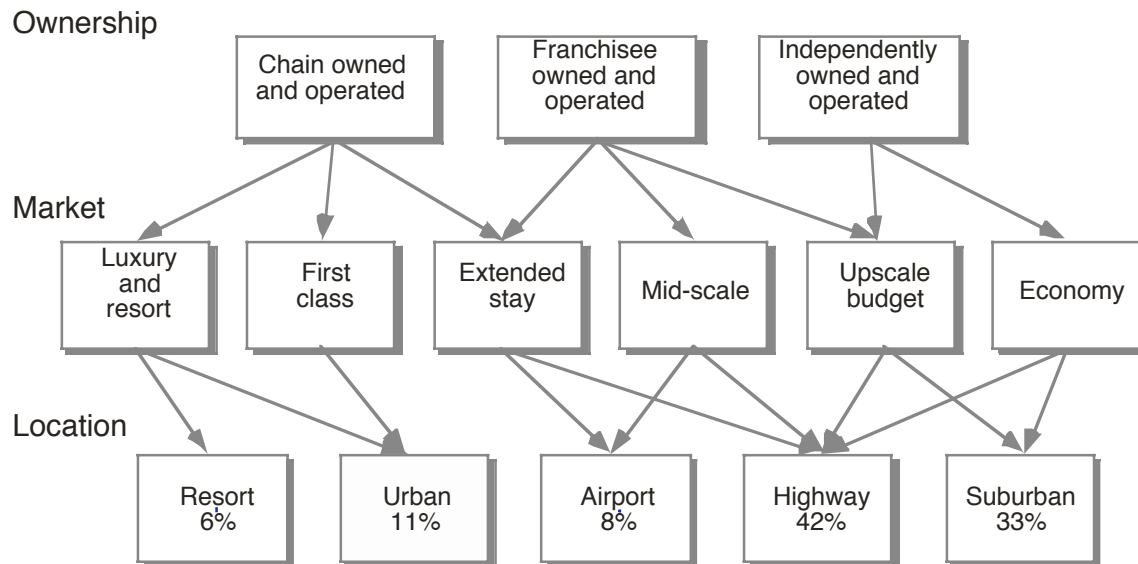
- Ownership and operation
- Target market or market segment
- Location

Ownership and operation

There are three basic types of lodging operations, chain owned and operated, franchise owned and operated, and independent (Figure 82). Chains build, develop, own, and manage lodging properties. Franchise operations are typically independent firms that own

and manage lodging under branding arrangements with the major chains. Franchise operators build, manage, operate, purchase supplies, market, and meet standards for their properties in accordance with their contracts and guidance from the major chains. The degree of control that franchisees have over their properties varies with the brand. In some cases, there is strict control over the image that includes standards for the building and the quality of the operation of the properties. Other brands may coordinate marketing but be less strict about image with respect to buildings and amenities.

Independent operators own and manage properties that are not affiliated with national and regional chains. Based on some 1997 research, we estimate that about 38 percent of lodging in the United States is owner operated and managed, 36 percent is franchisee



Source: Innovologie, LLC 2003

Figure 82 Lodging market structure¹⁴⁹

owned and operated, and 26 percent is independently owned and operated.

Target market or market segment

There are at least two ways to complementary ways to segment the lodging market, price and purpose of travel.

Price segments

The lodging sub-market has developed a complicated and diverse pricing and branding strategy that allows the chains to serve customers with a full range of lodging types from economy to luxury and resort. Table 37 presents one way of dividing the market based

¹⁴⁹ The lodging business is much less discrete than this diagram implies. The diagram is intended to show the major tendencies. For instance, economy and budget hotels tend to be found in suburban and highway locations. That is not to imply that they are not found elsewhere. There are independent owner/operators who own resorts or first class hotels although the majority of the independents are found along highways and in suburban areas.

on the average daily rate¹⁵⁰, not the retail rate, for the six sub-markets presented in Figure 82. Examples of brands that would fall into these categories are shown in column three of Table 37. The rates will vary by locale with higher average daily rates in large metropolitan areas and lower rates in others.

Table 37 Lodging price segments

Type	Average Daily Rate(ADR)	Hotel Brands
Luxury and resort	\$150+	Four Seasons, Hyatt, Renaissance, Westin, Ritz-Carlton, Wyndham
First class	\$125+	Crowne Plaza, Doubletree, Hilton, Marriott, Radisson, Sheraton
Mid-scale	\$75+	Amerisuites, Hampton Inns, Quality Inns, Clarion, Four Points, Holiday Inns
Extended Stay	\$75+	Residence Inn, Homewood Suites, and Embassy Suites
Upscale budget	\$60+	Best Western, Comfort Inns, Fairfield Inns, Howard Johnson, La Quinta
Economy	\$30+	EconoLodge, Knights Inn, Microtel, Motel 6, Red Roof Inn, Super 8

Source: College of Human Sciences, Texas Tech University www.hs.ttu.edu and American Hotel and Lodging Association

Table 38 gives an indication of the number of properties and rooms in the different sub-markets. The information in Table 38 is from a different source than that in Table 37 and thus does not precisely match, but it still gives an idea of the amount of lodging in the different price ranges. If the three categories encompassing the economy sub-sector as defined in Table 37 are combined, the economy sub-sector is the largest at about 38.6

Table 38 Number of properties and rooms by price range

Rate	Lodging type	Number of Properties	Percent of properties	Number of Rooms	Percent of rooms
Under \$30	Economy	1,695	4.1	95,378	2.3
\$30-\$44.99	Economy	7,101	17.2	503,167	12.0
\$45-\$59.99	Economy	13,722	33.2	1,017,463	24.3
\$60-\$85	Upscale budget/midscale	11,563	27.9	1,200,559	28.7
Over \$85	First class, luxury, resort, and extended stay	7,312	17.7	1,369,058	32.7
Total		41,393	100.1	4,185,625	100.0

Source: American Hotel and Lodging Association, 2001 Statistics at a Glance, website http://www.ahma.com/products_info_center_lip2002.asp

¹⁵⁰ The average daily rate is the average of what operators actually charge when they rent a room. Retail rates are often discounted or a premium is charged above the normal rate. The room rate can vary

percent of total rooms. The upscale and mid-scale market is just under 30 percent and the first class, luxury, resort, and extended stay sub-markets are slightly more than 30 percent. Most (85 percent) hotel properties have less than 149 rooms.

A second approach to segmentation leisure versus business travel

Price segments are one way to slice the lodging sub-market. Another is to slice the market by the services that are provided. Services include lodging, food service, shopping, and entertainment. Some hotels and motels target the leisure market while others target the business traveler.

Table 39 shows how this influences expenditures. The leisure segment, at \$135 billion, is about one third larger than the business segment. What is notable is how the expenditures break out. In the leisure segment, 60 percent of the expenditures occur for items other than room charges. Thirty percent of the expenditures are for food.¹⁵¹ Nearly half of the expenditures in the business segment are for rooms. Entertainment and shopping expenditures are very low.

Table 39 Expenditures in two different hotel/motel target markets

	Leisure hotel/motel (\$billions)	Business hotel/motel (\$billions)
Food	40.0	\$25.5
Room	\$33.3	\$46.1
Entertainment	\$26.8	\$8.0
Shopping	26.5	\$10.4
Miscellaneous	\$8.4	\$5.9
Total	\$135.1	\$95.9

Source: D.K. Shifflet and Associates, 7115 Leesburg Pike, Ste. 300, Falls Church, VA 22043 <http://www.dksa.com>

These differences are likely to influence energy use and therefore the targets of opportunity for energy efficiency. Leisure hotels may use significant amounts of energy to power water features, water golf courses, and provide other amenities. In the food services sub-market, we found that cooking was among the highest energy uses. Cooking may be a significant end-use in the leisure hotel segment as well. Business hotels are likely to focus on amenities in rooms and business services. Table 40 is a hypothesis about the importance of energy end-uses based on the market segment served. Further research is needed to verify these patterns. Whether or not this analysis closely

Table 40 Speculative assessment of the importance of energy end-uses in two lodging target segments

Energy End Use	Target Market	
	Leisure	Business
Heating	○	●
Cooling	●	●
Water heating	●	◎
Refrigeration	●	◎
Task lighting	○	●
Cooking	●	○
Specialized uses (pool heating, spas, saunas, golf courses, water features)	●	○

Heavy importance ● Medium importance ◎ Modest importance ○

hourly and daily in response to demand for rooms. Some of the staff of this project have observed the rates charged for rooms change while standing in line to register at lodging places.

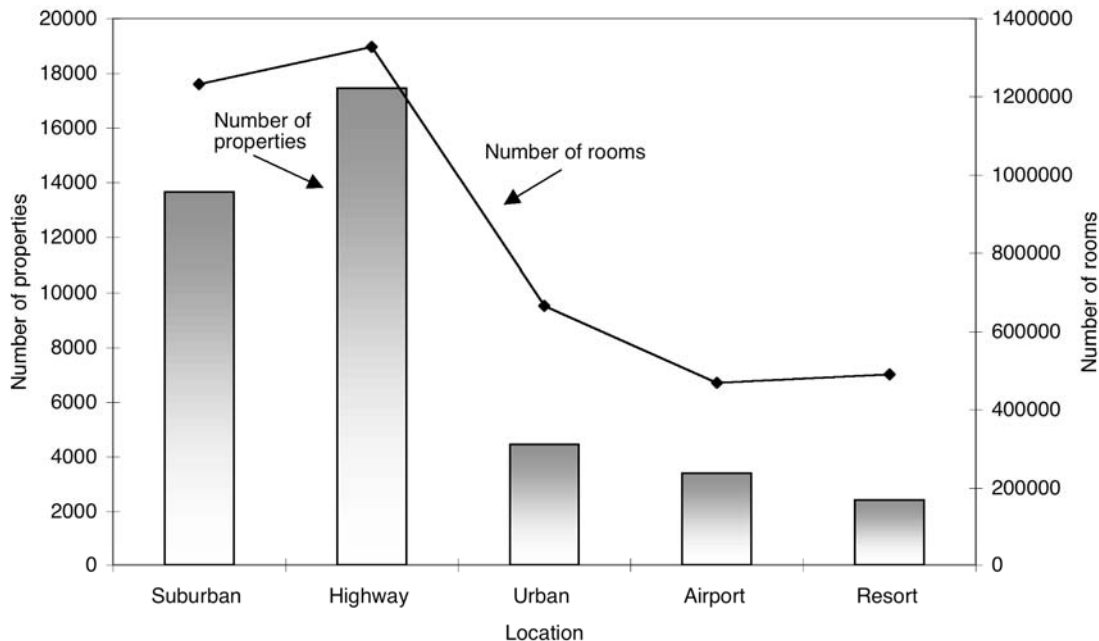
¹⁵¹ In the section on food sales, there was a brief discussion of embedded food sales. Food sales in hotels and resorts are considered to be embedded food sales.

corresponds to reality, the differences are suggestive.

Thinking about the target segment leads to an additional point. How one frames the energy efficiency message for the owner will depend on the target segments and the price point that a particular brand serves. For example, owners of budget and economy properties may be most interested in keeping overall costs low in order to keep them competitive. Ambiance and amenities may be less important to them because their customers may not have high expectations about these. By contrast, the luxury and resort markets and those catering to business travelers, while concerned about cost, are also concerned about amenities, ambiance, and other non-energy benefits. For those properties and their owners, the message regarding energy efficiency may be more appropriate if it focused on the non-energy benefits for the clientele – e.g., lighting, occupancy sensors, timing, and other more innovative and personalized energy management systems.

Location

The third criterion is location. Figure 83 shows the distribution of properties and rooms by location. The highest number of lodging locations is along highways (42 percent) and in the suburbs (33 percent) with the remaining locations accounting for 11 percent or less. If one compares the number of properties and rooms, it is clear that there are more rooms per property at urban, airport, and resort locations.



Sources: The American Economics Group, Inc.; D.K. Shifflet & Associates, Ltd.; Smith Travel Research; the Travel Industry Association of America; and the U.S. Department of Commerce, International Trade Administration, Office of Travel and Tourism Industries.

Figure 83 Number of properties and rooms by location

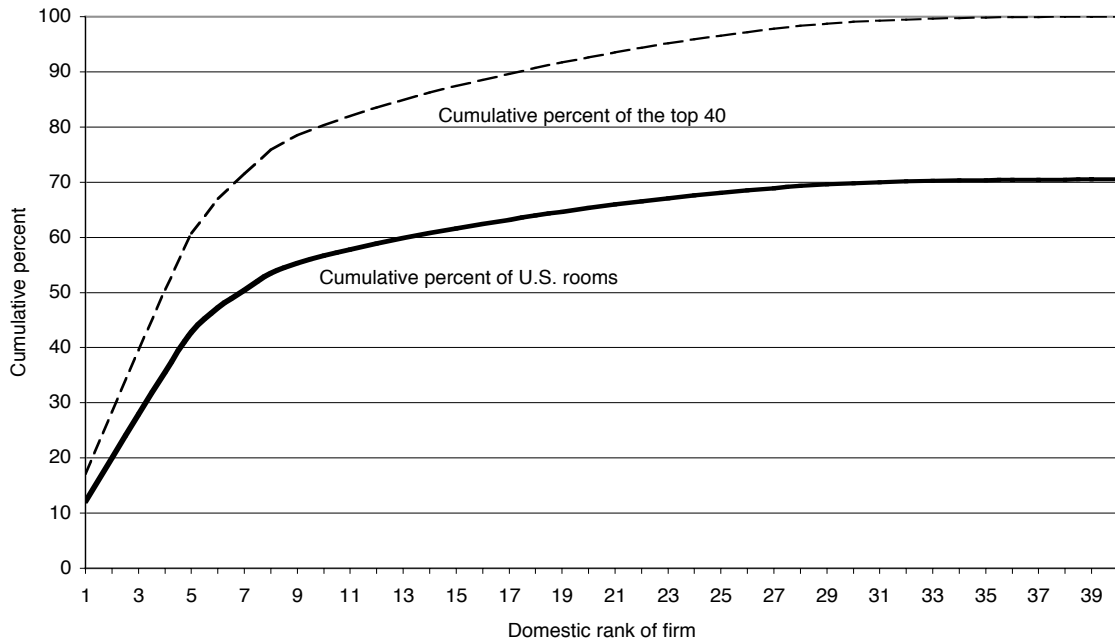
Location and target market are closely linked. For example, resort properties are located near amenities (or build their own) such as golf courses, swimming pools, beaches, shopping, and entertainment. Lodging accommodations situated on highways are designed to

attract travelers. Even here there is segmentation. Some hotels target families (e.g., Holiday Inn Kids Stay Free Campaign) and others target business travelers (e.g., Courtyard by Marriott).

The top lodging companies

Earlier we pointed out that a high percentage of lodging properties are independently owned. However, many of these independent owners are franchisees of national brands. The chains that own the brands play a significant role in defining the market, attracting customers, and dictating standards that the franchisees must follow. Although ownership appears to be fragmented, the actual decision-making in the lodging sub-market may be concentrated in a few major players.

Figure 84 presents the cumulative percentage of the rooms in the U.S. that are owned or franchised by the top 50 international lodging companies.¹⁵² Forty companies in the U.S. own or franchise about 70 percent of the rooms. What is more dramatic is that the top five firms own or franchise 43 percent of domestic lodging units and the top 10 firms own or franchise 57 percent of domestic lodging units. This indicates a very high degree of concentration and potentially represents a significant opportunity to influence energy



Source: 2002 Directory of Hotel & Lodging Companies

Figure 84 Cumulative percentage of total rooms in the U.S. and for U.S. lodging chains (40) that are in the top 50 international lodging chains

efficiency in the lodging market. If DOE could influence these leading lodging chains,

¹⁵² The table includes only the top 50 international lodging firms. Some top international firms may have fewer rooms in the U.S. than do international firms that fall lower in the international rankings or than firms whose operations are entirely within the U. S.

then they could possibly affect more than 1.8 million hotel rooms owned by the top five firms in the U.S. In fact, 10 lodging companies own 59 separate brands.

What are these lodging chains and what are their holdings? From Table 41, we see that the top five domestic lodging companies based on the international top 50 are Cendant, Hilton, Marriott, Six Continents, and Choice. Cendant owns a number of familiar brands such as Days Inn, Super 8, Ramada, etc. Six Continents is the Holiday Inn group.

Table 41 illustrates another point. The major lodging firms have brands at the major price points. For example, Marriott owns both the Renaissance and Ritz Carlton brands that are at the high end of the price spectrum and the more mid-priced Fairfield Inns. Hilton owns Hilton Hotels, Hampton Inn, and the Red Lion. Other lodging companies follow a similar strategy with brands in different price segments.

Table 41 U.S. holdings of the top 50 international lodging firms with U.S. properties¹⁵³

Chains and their brands Name	Domestic	
	Rooms	Properties
Cendant Corporation	506,830	6,083
Days Inn Worldwide	143,158	1,696
Super 8 Motels	119,010	1,949
Ramada Franchise Systems	119,238	967
Howard Johnson International	41,915	432
Travelodge Hotels	34,662	472
Knights Franchise Systems	17,833	222
Villager Franchise Systems	12,774	125
Wingate Inns	11,658	124
AmeriHost Franchise Systems, Inc.	6,582	96
Hilton Hotels Corporation	333,433	1,981
Hampton Inns	115,678	1,138
Hilton Hotels	96,556	232
Doubletree Guest Suites & Hotels	41,489	154
Embassy Suites	41,159	166
Hilton Garden Inns	17,381	125
Homewood Suites by Hilton	12,003	107
Red Lion Hotels & Inns	6,959	45
Harrison Conference Centers & Independents	2,208	14
Conrad International Hotels	0	0
Marriott International	332,114	1,945
Marriott Hotels, Resorts, & Suites and Ritz Carlton	120,571	291
Courtyard by Marriott	72,952	519
Fairfield Inns by Marriott	47,138	490
Residence Inns by Marriott	45,525	387

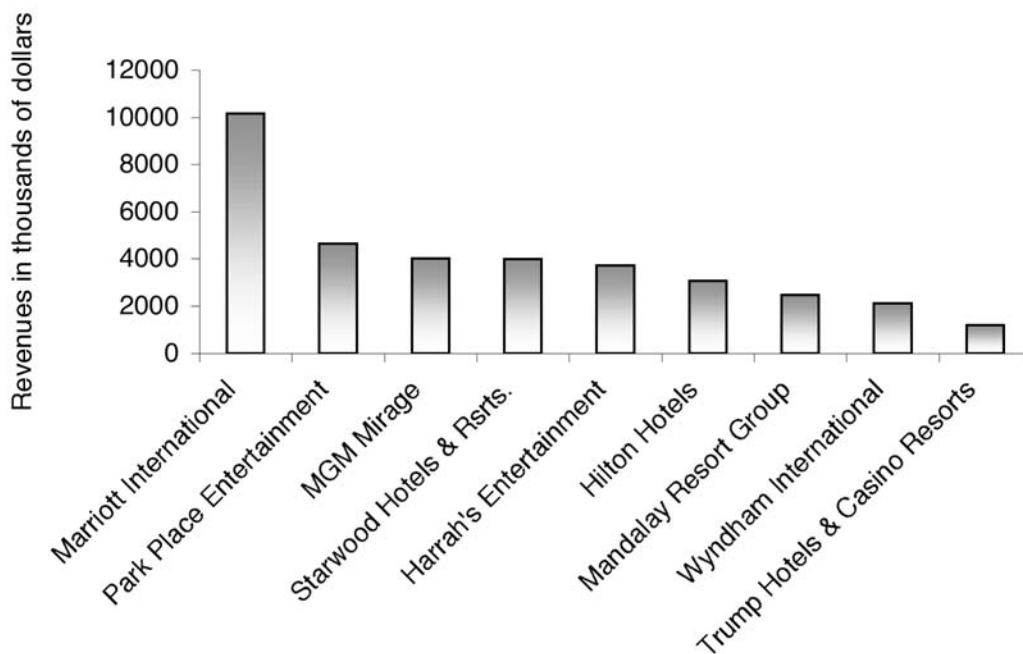
¹⁵³ This list is based on the top 50 international lodging firms. There are some domestic U.S. firms with more rooms than some of the firms at the bottom of this list but they have fewer rooms worldwide.

Chains and their brands	Domestic	
	Rooms	Properties
Renaissance Hotels and Resorts/Ramada International	22,430	58
TownePlace Suites by Marriott	10,261	99
Spring Hill Suites by Marriott	9,992	88
Marriott Conference Centers	3,245	13
Six Continents Hotels	321,524	2,386
Holiday Inn	177,055	956
Holiday Inn Express	91,989	1,187
Crowne Plaza	24,080	87
Inter-Continental Hotels & Resorts	2,560	12
Holiday Inn Select	19,336	75
Holiday Inn Garden Court	0	0
Holiday Inn Sunspree Resort	4,159	19
Forum Hotels & Resorts	0	0
Staybridge Suites by Holiday Inn	2,345	50
Choice Hotels International	303,115	3,735
Comfort Inns, Suites	140,021	1,785
Quality Inns, Suites & Hotels	55,488	520
Sleep Inns, Clarion Inns	46,752	486
EconoLodge	45,470	726
Flag Hotels, Suites & Inns	0	0
Rodeway Inns	10,092	155
MainStay Suites	5,272	62
Friendship Inns	20	1
Best Western International, Inc.	184,658	2,120
Accor	136,730	1,231
Motel 6*	85,433	816
Novotel	879	3
Red Roof Inns*	39,570	359
Mercure Hotels	0	0
Sofitel	2,632	8
Accor Leisure Division	0	0
Accor North America	3,764	11
Studio 6*	4,452	34
Starwood Hotels & Resorts Worldwide, Inc.	128,167	383
Sheraton Hotels, Inns & Resorts	68,022	186
Westin Hotels & Resorts	27,134	56
Four Points Hotels	21,914	111
St. Regis/Luxury Collection	5,578	16
W Hotels	5,519	14

Chains and their brands Name	Domestic	
	Rooms	Properties
Carlson Companies, Inc.	77,082	499
Radisson Hotels Worldwide	56,423	232
Country Inns & Suites by Carlson	20,659	267
Hyatt Hotels Corporation	55,409	111
FelCor Lodging Trust	46,961	177
MeriStar Hotels & Resorts, Inc.	46,758	229
U.S. Franchise Systems, Inc.	41,252	501
Microtel Inns & Suites	17,633	243
Hawthorn Suites	13,664	138
Best Inns & Suites	9,955	120
LaQuinta Inns, Inc.	39,280	303
Wyndham International, Inc.	35,514	151
Oakwood Worldwide	33,033	92
Prime Hospitality Corporation	32,041	242
Hospitality Properties Trust	31,486	230
Interstate Hotels	29,823	146
Mandalay Resort Group	27,303	16
MeriStar Hospitality Corporation	26,404	99
Tharaldson Lodging	24,239	349
Marcus Corp.	23,335	219
Baymont Inn & Suites	19,521	205
Marcus Hotels & Resorts	3,814	14
Walt Disney World Resorts	22,691	18
Homestead Village, Inc.	18,226	136
Preferred Hotels & Resorts Worldwide, Inc.	17,470	77
Suburban Lodges of America, Inc.	16,418	122
Omni Hotels	12,796	37
Millennium & Copthorne Hotels PLC	8,341	22
Four Seasons Hotels & Resorts, Inc.	7,523	26
Fairmont Hotels & Resorts	5,581	10
Olympus Real Estate Corporation	5,546	39
Royal Host	2,253	27
Le Meridien Hotels & Resorts	2,217	5
Prince Hotels	1,788	5
JAL Hotels Company, LTD	1,602	3
Hilton International Company	813	2
A.H.M.I.	387	3
Golden Tulip Worldwide	380	5

As we pointed out earlier, each brand has its own image and a single lodging chain, may own several brands. This may require those promoting energy efficiency across brands within a lodging firm to articulate somewhat different approaches and rationales for energy efficiency across brands. Cost is always a driver but it may be more important at the low end and less important at the high end. Controls may be more important in high end facilities where the front desk might start pre-cooling a room when a customer checks in.

If we examined hotels in terms of revenue, a different picture emerges. The firms with the largest revenues tend to be firms with resorts and casinos (Figure 85). This leads to another point, which is that the leading lodging firms tend to own higher end properties and franchises the lower end properties.



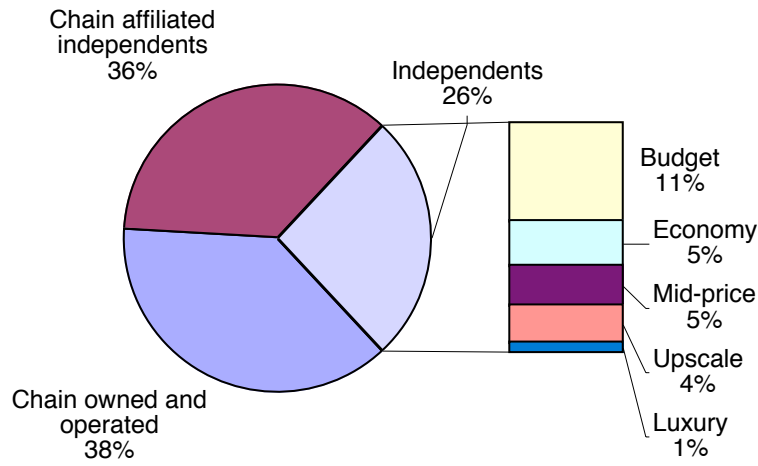
Source: Fortune Magazine, April 15, 2002 Issue

Figure 85 Top 10 lodging companies by revenues

Independently owned hotels

Up to now, this chapter has been focused on the importance of the major lodging firms. There are approximately 2.6 million rooms that are owned by independent firms. Based on the Smith Travel Research U.S. Lodging Census database, there are approximately 14,000 independently owned and operated hotels with 1.1 million guest rooms representing about 26 percent of all rooms.¹⁵⁴ Figure 86 shows that more than 40 percent of the rooms owned by independents (11 percent of all rooms) are in the budget category.

¹⁵⁴ Ross, Chuck, "Doing Well On Their Own--Rising room rates, little new construction make for an attractive combination for independent properties", *Lodging Magazine*, November, 1997

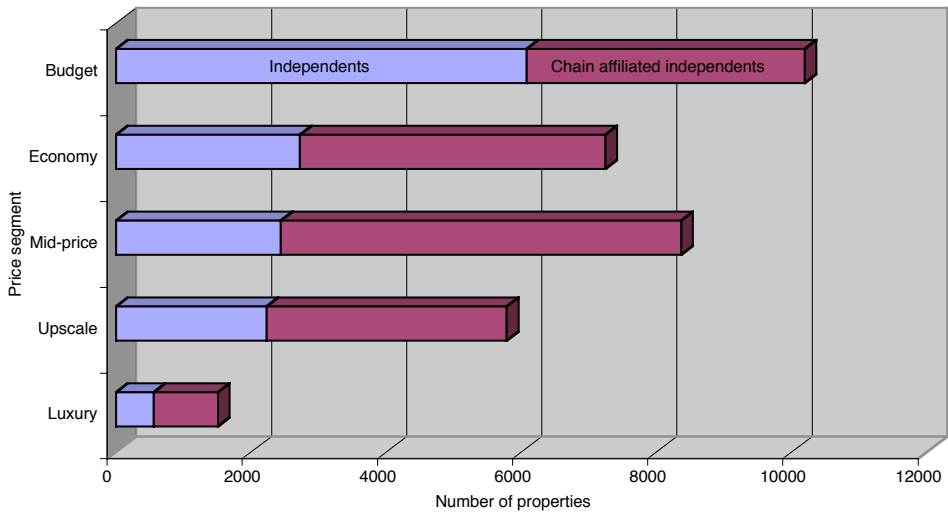


Source: Adapted by Innovologie from Smith Travel Research, Chuck Ross, *Lodging Magazine*, November 1997

Figure 86 Percentage of rooms operated by chains, chain affiliated independents, and independent operators

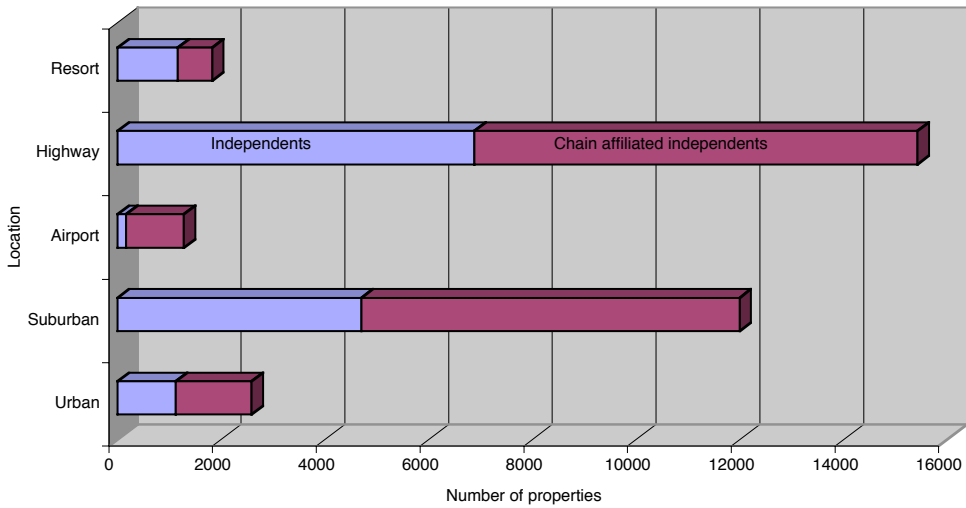
Figure 87 shows that independents are more likely to be found in the budget category than in other categories when compared to chain affiliated independents. As one might expect based on the price segmentation, independents are more likely to be found in highway locations (Figure 88). Finally, the units that independents own are typically smaller than the units owned by chain affiliated operators.

Independent hotels operate in every price class in this industry. Independent owners and operators dominate the resort class. They own 60 percent of the hotels and 56 percent of all guest rooms in resort areas. This is due to the large concentration of independently owned resorts in vacation destinations such as Orlando and Las Vegas.



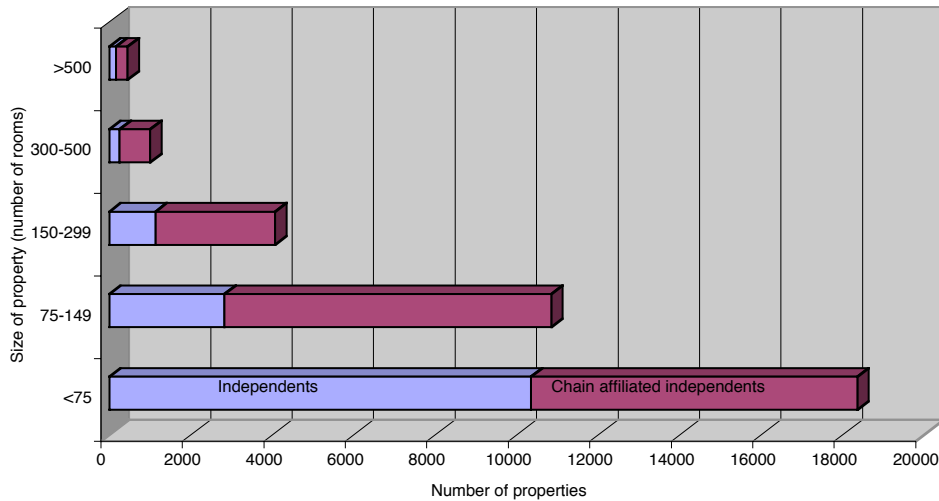
Source: Adapted by Innovologie from Smith Travel Research, Chuck Ross, *Lodging Magazine*, November 1997

Figure 87 Price segment for properties owned by chain affiliated and independent operators



Source: Adapted by Innovologie from Smith Travel Research, Chuck Ross, *Lodging Magazine*, November 1997

Figure 88 Location of chain affiliated and independent operators



Source: Adapted by Innovologie from Smith Travel Research, Chuck Ross, *Lodging Magazine*, November 1997

Figure 89 A comparison of the size of properties owned by independents and chain affiliated independents

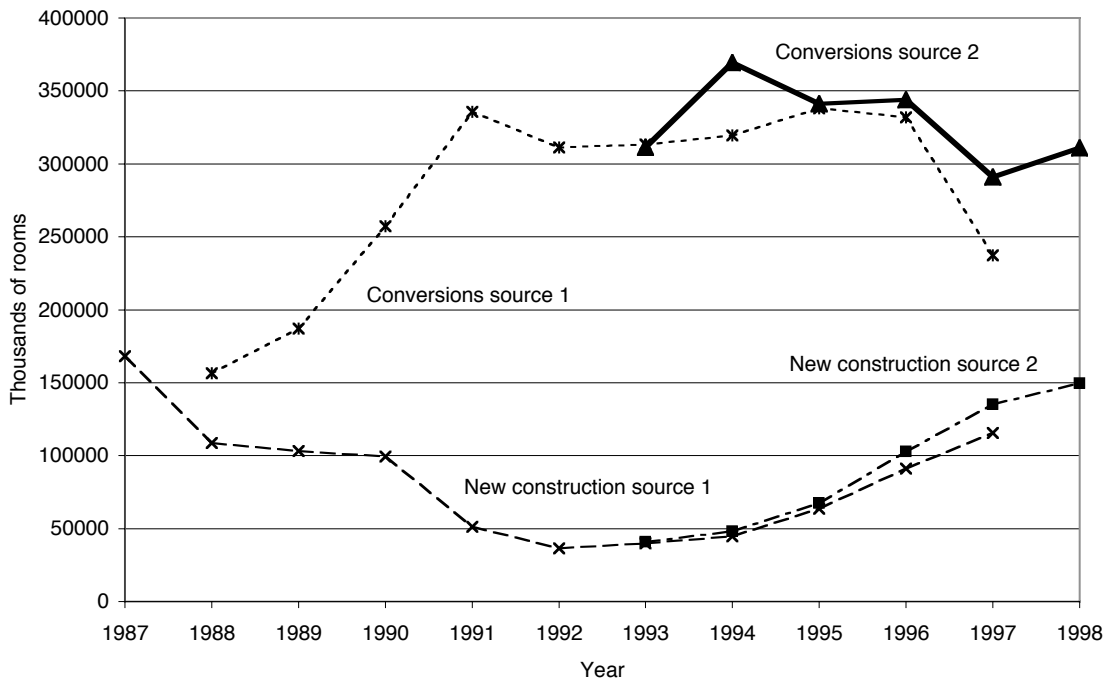
Construction trends

Figure 90 shows two data series describing construction trends in the lodging industry. The same firm and individual provide both sources. Source one appears to be for growing firms while source two appears to be for all firms. In any event, the numbers are quite close.

Between 100 and 150 thousand new rooms were constructed annually during the period between 1987 and 1998 except for the period between 1991 and 1995 when the number of new rooms constructed was between 40,000 and 70,000 annually. The upward trend from 1993 continued through 2000. After eight consecutive years of growth, investment in new hotel and motel construction fell 11 percent in 2001, according to FMI's *Construction Outlook: First Quarter 2002 Report*. Property improvements are not expected to achieve positive growth until 2004. In 2001, the lodging sub-market spent \$9.77 billion on new construction projects and \$4.26 billion on improvements.¹⁵⁵

The other set of curves in Figure 90 are conversions. In the industry parlance, a conversion occurs when a property moves from one “flag” to another. The important point is that conversion units are about three times the number of new units. Further, the rate of annual conversions is between seven and eight percent of the total number of rooms. While some conversions involve a change of signage and are cosmetic, other conversions involve extensive remodeling. Many conversions provide opportunities to improve energy efficiency as well.

¹⁵⁵ *Extended-Stay Lodging Industry in the United States – 2001*, *Lodging Magazine*, May 2002. Newsletter – May 27, 2002, Lodging Trends, <http://www.ehotelier.com/newsletter/May27.htm>.



Sources: Smith Travel Research, Source 1, Mark V. Lomano, "Build vs. Convert (Trends and Statistics)," *Hotel and Motel Management*, February 1998; Source 2, Mark V. Lomano, "Construction vs. Conversions (Trends and Statistics)," *Hotel and Motel Management*, June 1999

Figure 90 New construction and conversions in the lodging sector 1987 - 1998

Operating costs

Given high operating costs and thin margins, energy expenses represent a potential opportunity for lodging establishments to trim costs. Energy expenses comprise four to five percent of revenues. During economic downturns, hotel operators are more willing to institute energy saving strategies to further reduce costs. Ernst & Young estimate that hoteliers can save 15 to 20 percent on energy costs through conservation and energy efficiency strategies.

Lodging trends

Within the lodging sub-market, the extended-stay category is the fastest growing segment, with room supply increasing by nearly 10 percent in 2001. According to the Highland Group's Report on *Extended-Stay Lodging Industry in the United States-2001*, this category now represents five percent of the total U.S. hotel room supply. It is projected to grow at an average of five percent through 2006.¹⁵⁶

Another major trend within this industry is the growing use of the Internet in hotel rooms. According to a study by In-Stat:

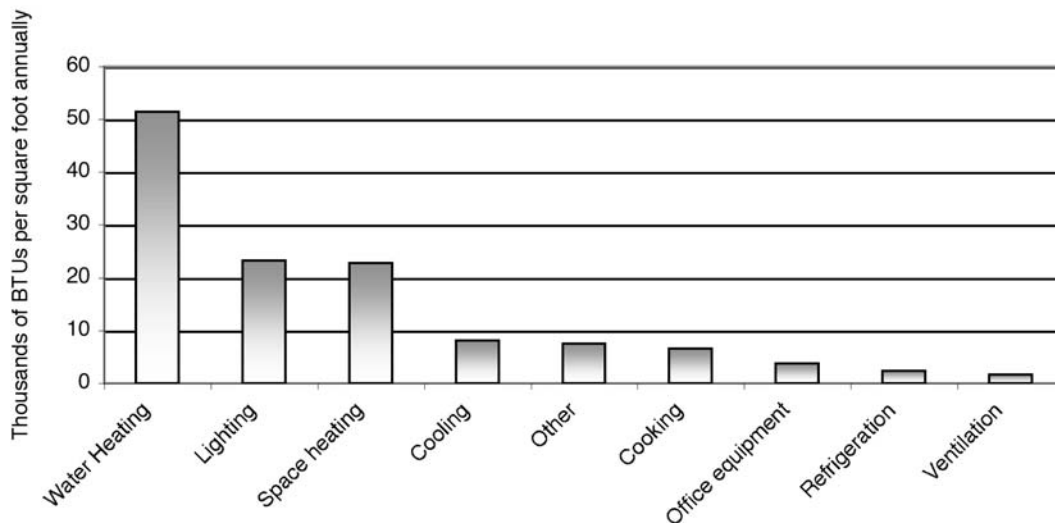
¹⁵⁶ *Extended-Stay Lodging Industry in the United States - 2001*, *Lodging Magazine*, May 2002. Newsletter - May 27, 2002, Lodging Trends, <http://www.ehotelier.com/newsletter/May27.htm>.

- Seventy-three percent of hotels are considering high speed Internet access for their guestrooms and an even higher percentage (82 percent) of hotels with business clientele exceeding 60 percent are considering rolling out broadband to customers' rooms.
- Fifty-six percent of hotels plan to wire at least half of their guest rooms for Internet access.

There is also a shift in business travel. According to a WorldCom survey, 75 percent of business travelers have switched to email, telephone, and teleconferencing as a substitute for face-to-face meetings. Based on interviews with 323 business travelers who have taken three or more trips by air for business purposes during the past year, video, audio, and Web conferencing technologies are being used with increasing frequency. More than half (55 percent) of the respondents said that they have used some form of virtual conferencing to conduct business. Sixty-two percent say they will use such systems with regularity in the future.¹⁵⁷

End-use intensities in the lodging market

Water heating has the highest energy intensity (52,000 Btus per square foot annually) in the lodging sector. It is more than double the intensity of the lighting. If space heating, cooling, and ventilation are combined, the intensity of these end-uses is about 32,500 Btus per square foot annually. Thus, energy use intensity for space conditioning is about 60 percent of that for water heating.



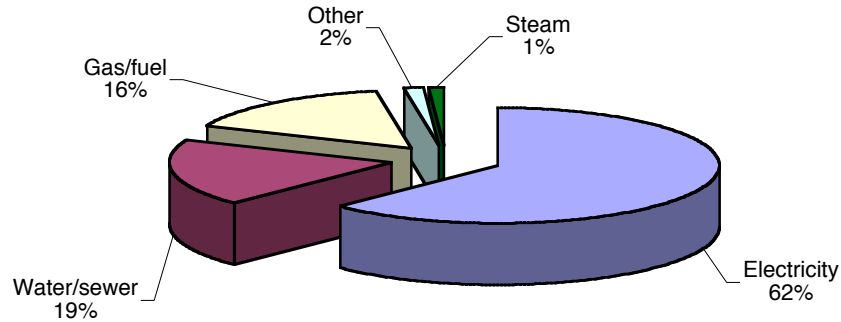
Source: EIA, CBECS, 1995, Table EU4

Figure 91 Energy intensities in the lodging sub-market

According to PKF Consulting, the cost of utilities is \$1,423 per average available room use. Figure 92 shows that most of the cost is electricity, followed by water and sewer. About 16 percent is for gas or other fuel.

¹⁵⁷ Extended-Stay Lodging Industry in the United States – 2001, Lodging Magazine, May 2002. Newsletter – May 27, 2002, Lodging Trends, <http://www.ehotelier.com/newsletter/May27.htm>.

There appears to be an interesting discrepancy between this graphic and the previous one. Figure 91 shows that water heating is the most intense use. Shortly, we shall see that water is mostly centrally heated. Taken in combination, these graphics would imply that a substantial amount of water is heated with electricity. It is not clear if this is the case or an artifact of the heating value and cost of fuels.

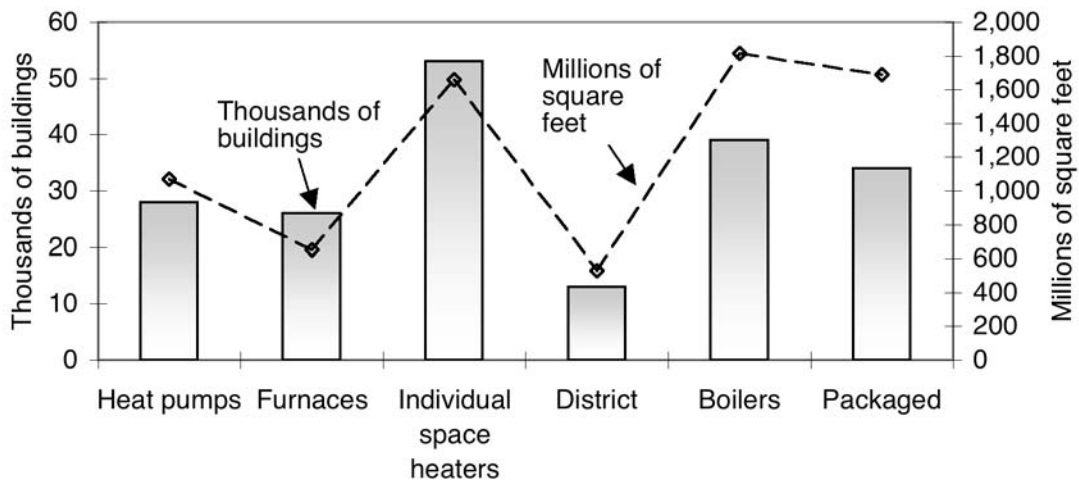


Source: The Hospitality Research Group of PKF Consulting; average cost of utilities is \$1,423 per available

Figure 92 Breakdown of the cost of utilities for the average hotel room

Energy using technologies in the sub-market

Nearly all the floor space in the lodging sub-market is heated (98 percent). However, no one type of heating equipment dominates this market. Rather, space heaters, boilers, and packaged units are found in buildings with 38 percent, 41 percent, and 38 percent of total floor space in the sub-market, respectively (Figure 93). The reader should note that floor

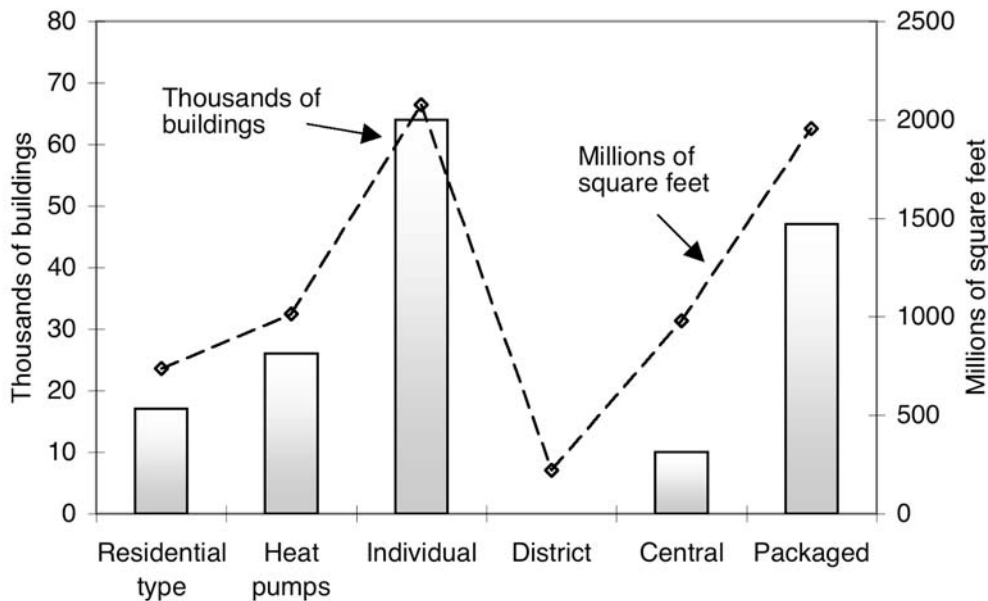


Source: EIA, CBECS 1999 Tables B32-33

Figure 93 Type of heating equipment in the lodging sub-market

space could have more than one type of heating. Boilers and packaged units appear to be found in larger buildings.

Ninety percent of all lodging floor space is cooled. Individual cooling units are found in buildings accounting for 51 percent and packaged units in buildings accounting for 48 percent of the floor space. Heat pumps and central chillers are found in buildings accounting for roughly one-quarter of the total floor space (Figure 94). Different types of units can be found in the same buildings.



Source: EIA, CBECS 1999 Tables B34-35

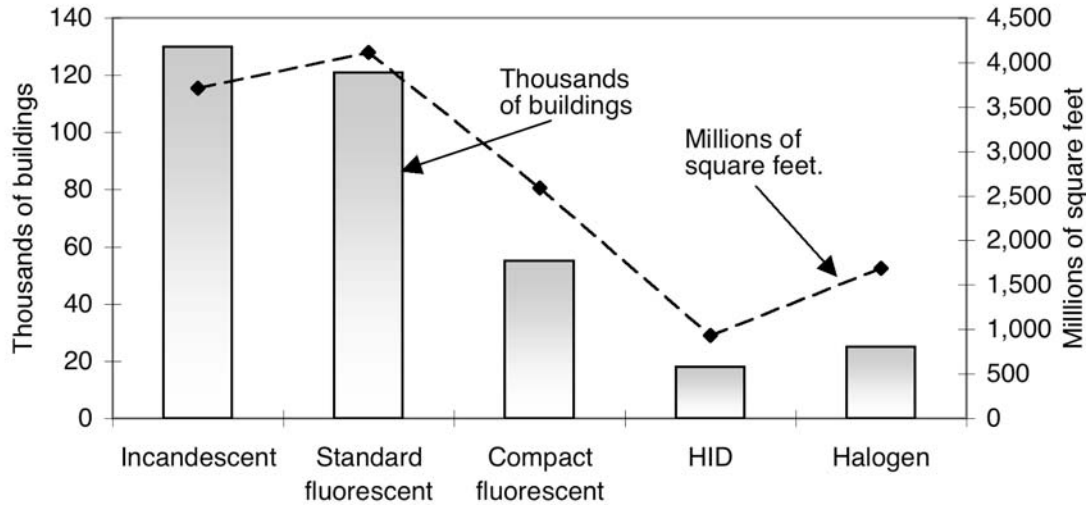
Figure 94 Types of cooling equipment in the lodging sub-market

Lighting equipment

Nearly all lodging floor space is lit (99 percent). Standard fluorescent and incandescent fixtures are found in buildings accounting for 92 percent and 83 percent of the total floor space, respectively. Compact fluorescent lights, halogen and HID fixtures are found in buildings accounting for 58 percent, 38 percent, and 21 percent of the total floor space in the sub-market.

Refrigeration equipment

Approximately one-fifth of all lodging buildings that account for more than half (53 percent) of the total lodging floor space have refrigeration equipment. Most of the refrigeration equipment installed in this sub-market is either walk-in (84 percent of the floor space with refrigeration) or closed cases (86 percent of the floor space with refrigeration)



Source: EIA, CBECs 1999 Tables B38-39

Figure 95 Types of lighting equipment in the lodging sub-market

Water heating

Nearly all lodging establishments (97 percent) use some type of water heating. Buildings accounting for 83 percent of the floor space have central water heating supplying at least parts of the buildings.

Penetration of efficient technologies

Table 42 displays the level of penetration of efficiency related technologies in buildings in the lodging sector. The technology that is found in buildings with the most floor space is the electronic ballast. This would suggest that more efficient linear fluorescent technology has penetrated the market to a substantial degree. Buildings with about half of the floor space have multi-paned windows. Energy management systems are found in slightly more than one-quarter of the buildings. The other technologies are found in buildings representing about one-quarter of the floor space. These technologies would not necessarily be appropriate in every lodging building. Thus, their penetration of eligible space is probably higher than this table would indicate.

Table 42 Penetration of efficient technologies in the lodging sub-market

Measure	Billions of square feet for buildings having the measure	Percent of total lodging square feet (3.6 billion)
Electronic ballasts	2.40	67
Multi-paned windows	1.80	50
Variable air volume systems	1.00	28
Energy management systems	1.00	28
Specular reflectors	0.97	27
Skylights and atriums	0.85	24

Source: EIA, CBECs public use sample, 1999 as analyzed by Innovologie, LLC. Square footage is the square footage for buildings having the measure. Not all of the space in a building may have the measure.

Summary and conclusions

The lodging segment is one of the smallest commercial building sub-markets, accounting for approximately 175,000 buildings and four billion square feet of commercial floor space. The 175,000 buildings are found at 53,000 properties with more than 4.2 million rooms. According to Smith Travel Research, there are 41,963 properties and 4.2 million rooms at properties with more than 15 rooms. In 2001, this sub-market had \$103.6 billion in sales and \$16.1 billion in pre-tax profits.

Segmentation within the industry

The lodging industry can be segmented by ownership and operation, target market, and location. Based on 1997 research, 38 percent of lodging in the U.S. is owner operated and managed; 36 percent is franchisee owned and operated; and 26 percent is independently owned and operated. The industry is price driven with large firms owning numerous brands that are oriented to specific price points and business and leisure markets. If the price points are identified in three categories, the economy sub-market is the largest at about 38.6 percent of total rooms. The upscale and mid-scale market is just under 30 percent and the first class, luxury, resort, and extended stay sub-markets are slightly more than 30 percent.

The lodging industry offers a variety of services including lodging, food service, shopping, and entertainment. Some hotels and motels target the leisure market while others target the business traveler. In the leisure segment, sixty percent of the expenditures occur for items other than room charges. Thirty percent of the expenditures are for food. Nearly half of the expenditures in the business segment are for rooms. This is important because how one frames the energy efficiency message for the owner/operator will depend on the target segments and the price point that a particular brand serves.

The highest percentage of lodging locations is found along highways (42 percent) and in the suburbs (33 percent) with the remaining locations accounting for 11 percent or less. If one compares the number of rooms and the number of properties, there are more rooms per property at urban, airport, and resort locations.

Forty companies in the U.S. own or franchise about 70 percent of the rooms. The top five firms own or franchise 43 percent of domestic lodging units and the top 10 firms own or franchise 57 percent of domestic lodging units. This indicates a very high degree of concentration and potentially represents a significant opportunity to influence energy efficiency in the lodging market.

While several brands may be owned by a single lodging firm, brands are intended to differentiate the product. Those who promote energy efficiency across brands within a lodging firm may need to articulate different approaches and rationales for energy efficiency for each brand. Cost is always a driver but it may be more important at the low end and less important at the high end. Controls may be more important in high-end facilities where the front desk might start pre-cooling a room when customers register.

Independents are more likely to be found in the budget category than in other categories when compared to chain affiliated independents. Also, independents are more likely to

be found in highway locations. Finally, the units that independents own typically have fewer rooms than the units owned by chain affiliated operators.

However, independent hotels operate in every price class in this industry. Independent owners and operators dominate the resort class. They own 60 percent of the hotels and 56 percent of all guest rooms in resort areas. This is due to the large concentration of independently owned resorts in vacation destinations such as Orlando and Las Vegas.

Construction trends

Between 100 and 150 thousand new rooms were constructed annually during the period between 1987 and 1998 except for the period between 1991 and 1995 when the number of new rooms constructed was between 40 and 70 thousand annually. This means that a significant number of rooms are built in any given year. The extended stay category now represents five percent of the total U.S. hotel room supply. It is projected to grow at an average of five percent through 2006.

Conversions occur when a property moves from one “flag” to another. The number of conversions is about three times the amount of new construction. Further, the rate of annual conversions is between seven and eight percent of the total number of rooms. While some conversions involve a change of signage and are cosmetic, other conversions involve extensive remodeling. Conversions are a target of opportunity for improving energy efficiency.

The future

How the industry will fare in the next few years is highly dependent upon changes that are taking place in business. Seventy-five percent of business travelers have switched to email, telephone, and teleconferencing as a substitute for face-to-face meetings. Based on interviews with 323 business travelers who have taken three or more trips by air for business purposes during the past year, video, audio, and Web conferencing technologies are being used with increasing frequency. More than half (55 percent) of the respondents said they have used some form of virtual conferencing to conduct business. Sixty-two percent say they will use such systems with regularity in the future.

Energy end-use

Water heating has the highest energy intensity (52,000 Btus per square foot annually) in the lodging sector. It is more than double the intensity of lighting. Buildings accounting for 83 percent of the floor space have central water heating supplying at least parts of buildings.

If space heating, cooling, and ventilation are combined, the intensity of these end-uses is about 32,500 Btus per square foot annually. Thus, energy use intensity for space conditioning is about 60 percent of that for water heating. No one type of heating equipment dominates this market. Individual air conditioners and packaged units predominate in the cooling market.

Standard fluorescent and incandescent fixtures are found in buildings accounting for 92 percent and 83 percent of the total floor space, respectively. There is some evidence that efficient linear fluorescents are well on their way to penetrating this market.

The degree to which other types of efficiency measures may have penetrated the market is less clear.

The key findings from the lodging industry

Perhaps the most important finding for the lodging sub-market is the high degree of concentration of ownership and franchising. This industry can be targeted through the large national firms with their numerous brands and their franchisees. We do not know to what extent energy efficiency is important to the players in this market. Energy is a cost and we do know that some of the firms are paying attention. Also, we should not overlook the independent operators that are probably best addressed through local and regional organizations.

Another very important point is the role of price and branding. The major lodging firms have chains at different price points. The pitch for energy efficiency may need to differ with the brand within the same firm. At the low end, the message may need to be that of reducing cost. At the high end, the message to the owner may need to focus on ways to improve customer service that just happen to lead to reduced energy use.

There is some evidence that the lodging industry has paid some attention to energy efficiency. It appears that efficient standard fluorescent lighting is widely used. However, there are other areas where it appears technologies such as energy management systems could be used. An important point to keep in mind is that the heating and cooling technologies that are used in this industry are distributed technologies. However, the production of hot water is mostly a centralized technology in this industry.

Current trends in the business sector may drive this sub-market more in the direction of leisure properties than business properties. Energy use is very different between the two kinds of properties and the ownership patterns are as well.

A last point is that annually there is major new construction in this sub-market. However, there is much more conversion activity. The conversion activity may present important opportunities for addressing the energy efficiency issue.

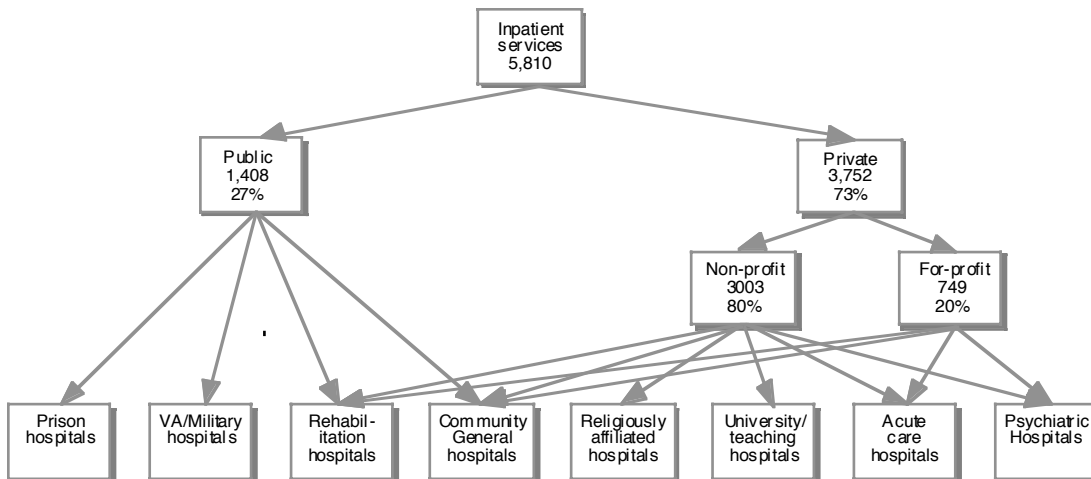
Chapter 9 The Health Care Sub-market

There are about 100,000 buildings containing approximately three billion square feet of floor space that support inpatient and outpatient healthcare services in the U.S. The healthcare facilities industry includes a broad range of organizational types that serve a broad range of human healthcare needs. There is the inpatient sector that includes acute care hospitals, rehabilitation hospitals, and psychiatric hospitals. Outpatient services are delivered outside of the hospital setting and include patient services, nursing homes, assisted living facilities, and home health care services.

This division of the market is important for three reasons. In terms of square footage, the inpatient market (1.9 billion square feet) is larger than the outpatient market (1.1 billion square feet). The second is that energy use intensities in the inpatient sub-market are three to four times the energy intensities in the outpatient sub-market. Thirdly, the long-term trend is for services to move from the inpatient to the outpatient market. Thus, in future years, the inpatient market is likely to continue to shrink while the outpatient market will grow.

Inpatient healthcare services in the United States

Figure 96 illustrates the various organizations involved in inpatient care. It also gives some indication of the relative size of various sub-markets.



Source: Innovologie, LLC, 2003

Figure 96 Healthcare market structure of inpatient services

The inpatient sub-market includes both public and privately owned hospitals. Many private hospital chains are owned by religious or social organizations (i.e., the Catholic Healthcare System, Shriner's Hospitals). The acute care hospitals are the traditional patient care hospitals mostly comprised of nonprofit entities. Non-profit hospitals make up 85 percent of the sub-market. In recent years, these nonprofit hospitals are being replaced by for-profit and tax exempt chains.

Healthcare terminology¹⁵⁸

Registered hospitals: hospitals that meet AHA's criteria for registration as a hospital facility. Registered hospitals include AHA member hospitals as well as nonmember hospitals.

Acute care hospitals: traditional patient care hospitals comprised of nonprofit entities. Nonprofit hospitals make up 85 percent of the entire sub-market. In recent years, these are being replaced by for-profit and tax exempt chains, particularly HCA and Tenet.

Rehabilitation hospitals: provide services to patients with disabilities such as head injuries, orthopedic care, neuromuscular disease, and stroke. Services can include sports medicine, occupational therapy, respiratory therapy, and speech therapy.

Psychiatric hospitals: provide treatment programs for alcohol, drug dependency, and other mental disorders. Treatment ranges from testing, adjunctive therapy, group therapy, and educational programs.

Community hospitals: all nonfederal, short-term general, and other special hospitals. Other special hospitals include obstetrics and gynecology; eye, ear, nose, and throat; rehabilitation; orthopedic; and other individually described specialty services. Community hospitals include academic medical centers or other teaching hospitals if they are nonfederal short-term hospitals. Excluded are hospitals not accessible by the general public, such as prison hospitals or college infirmaries.

System: a multi-hospital or a diversified single hospital system. A multi-hospital system is two or more hospitals owned, leased, sponsored, or contract managed by a central organization. Single, freestanding hospitals may be categorized as a system by bringing into membership three or more, and at least 25 percent, of their owned or leased non-hospital pre-acute or post-acute health care organizations. System affiliation does not preclude network participation.

Network: is a group of hospitals, physicians, other providers, insurers and/or community agencies that work together to coordinate and deliver a broad spectrum of services to their community.

Table 1 summarizes the type and number of organizations operating inpatient facilities. About 85 percent of hospitals are community hospitals. Most of these hospitals (52 percent) are owned and operated by private agencies and organizations. About 20 percent are owned and operated by state and local governments, and about 13 percent of these hospitals are investor owned.

¹⁵⁸ http://www.hospitalconnect.com/aha/resource_center/fastfacts/fast_facts_US_hospitals.html.

Table 43 Distribution of hospitals in the United States

Type of hospital	Number	Subtotal	Percent of subtotal
Total of all US registered hospitals		5,810	
Community hospitals			
Nongovernment not-for-profit	3,003		52
Investor owned (for-profit)	749		13
State and local government	1,163		20
Other hospitals			
Federal government hospitals	245		4
Nonfederal long term care hospitals	631		11
Hospital units of institutions (prison hospitals, college infirmaries, etc.)	19		0.3
Total of US community hospitals		4,915	
Number of rural hospitals	2,175		44
Number of urban hospitals	2,740		56

Source: AHA Hospital Statistics, 2002

The players in the in-patient healthcare market

There is some concentration in the inpatient care market. Table 44 displays the largest privately owned hospital chains. The top 10 players owned a total of 815 hospitals in 2000. Because this market is so dynamic, the names and numbers are constantly changing. Given 4,000 privately owned hospitals, these 10 players own about 20 percent of the total hospitals. The bulk of the hospitals owned by HCA and Tenet are acute care hospitals as can be seen by comparing Table 45 to Table 44.

Table 44 Largest hospital chains in the United States

Rank	Largest hospital chains	Total number of members
1	HCA – The Healthcare Company*	224
2	Tenet/Buypower	162
3	HealthSouth	91
4	Magellan Health Services	87
5	Vencor	55
6	Select Medical Corporation	44
7	Behavioral Health Systems	43
8	Community Health Systems	41
9	Catholic Healthcare West	38
10	Mercy Health Services	30

Source: SMG Marketing Group, 2000
www.hpnonline.com/resources/hospitalfacts.html * Formerly Columbia/HCA Healthcare Corp.

Table 45 identifies the largest hospital chains operating acute care hospitals and the number of players in this market. HCA/Health Care Corp. is the largest private owner of acute care hospitals in the United States dominating the acute care hospital market. The Department of Veterans Affairs, a governmental organization, is the next largest player followed by Tenet Healthcare. The remaining large players in the acute care market have a third or fewer hospitals than the larger players. Notice that several of these organizations are non-profit entities.

When we examine healthcare system revenues, we see yet another pattern. The Department of Veterans Affairs and Columbia/HCA had the largest revenues in 1999. Tenet Healthcare ran a distant third and a variety of other healthcare systems had revenues that were a quarter or less than those of the Department of Veterans Affairs. We also see some of the large major urban hospitals emerge.

Yet another picture emerges when one examines the number of acute care beds (Table 47). Among the for-profit systems, Columbia/HCA and Tenet Healthcare had by far the largest number of beds. There are several Catholic hospital systems among the not-for-profit systems.

Table 45 Largest hospital chains by number of acute care hospitals

	Largest healthcare systems	Total number of acute care hospitals
1	Columbia/HCA Healthcare Corp.	203
2	Department of Veterans Affairs	173
3	Tenet Healthcare Corp.	130
4	Catholic Health Initiatives	69
5	Ascension Health	60
6	Catholic Healthcare West	48
7	Community Health Systems	46
8	Catholic Health East	32
9	Health Management Assoc.	32
10	Marian Health System	31

Source: Modern Healthcare, 2000,
www.hpnonline.com/resources/hospitalfacts.html

Table 46 Largest healthcare systems by revenues (1999 self-reported figures)

Rank	Largest healthcare systems	Net patient revenues (in billions)
1	Department of Veterans Affairs	\$20.7
2	Columbia/HCA	\$16.7
3	Tenet Healthcare Corp.	\$10.0
4	Ascension Health	\$5.5
5	Catholic Health Initiatives	\$4.8
6	Catholic Healthcare West	\$4.0
7	NY City Health and Hospitals Corp.	\$3.7
8	NY Presbyterian Healthcare System	\$3.0
9	Mayo Foundation	\$2.8
10	North Shore Long Island Jewish Health System	\$2.3

Source: Modern Healthcare, 2000

Table 47 Number of acute care beds by for-profit and not-for-profit systems

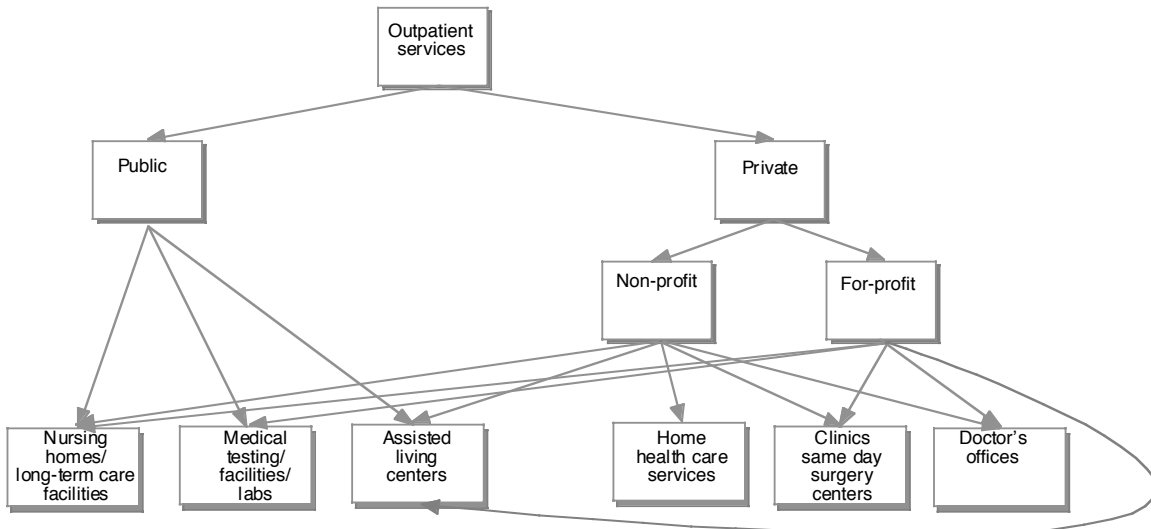
For-profit systems		Not-for-profit systems		
Rank		Number of acute care beds	Number of acute care beds	
1	Columbia/HCA	45,200	Dept. of Veterans Affairs	21,600
2	Tenet Healthcare Corp.	30,800	Ascension Health	12,700
3	Universal Health Services	4,800	Catholic Health Initiatives	10,000
4	Triad Hospitals	4,600	Christus Health	9,600
5	Health Management. Assoc.	4,400	Catholic Health East	8,800
6	Quorum Health Group	3,700	Catholic Healthcare West	8,200
7	Community Health Systems	3,100	Mercy Health Services	5,900
8	Life Point Hospitals	2,200	Sutter Health	5,800
9	New American Healthcare Corp.	1,300	NY Presbyterian Healthcare System	5,300
10	Province Healthcare Corp.	1,200	Catholic Healthcare Partners	5,200

Source: Modern Healthcare, 2000

What these data show are that there are basically four sub-markets: Federal hospitals mostly run by the Department of Veterans affairs, large investor owned systems, and a number of sizable not-for-profit systems. Below this are a large number of much smaller systems as well as individual hospital both public and private.

Outpatient services

Figure 97 represents a structure for understanding outpatient services. Out-patient services have grown substantially given technological advances and the advent of managed care as managed care organizations have shifted services from higher cost in-patient care



Source: Innovologie, LLC.

Figure 97 Health care market structure in outpatient services

to lower cost outpatient care. In providing outpatient services, public and private organizations operate a variety of facilities such as laboratories and medical office suites.

Home healthcare facilities focus on respiratory programs for patients suffering from ailments such as asthma, emphysema, chronic bronchitis, and cystic fibrosis. Some providers offer oxygen systems, pressure cylinders, and portable units for adults and newborns. These companies also provide intravenous and infusion services. This includes the delivery of nutrients and drugs intravenously, through feeding tubes. Intravenous drugs can include antibiotics and analgesics used to treat conditions such as AIDS and cancer. Infusion therapies include services for patients with dysfunctional digestive tracts.

Assisted living centers serve elderly persons who do not require intensive medical care. They provide 24-hour supervision of their residents and assume almost total responsibility for their care. Services are provided on private pay arrangements.

The assisted living center business is very fragmented and dominated by many small private firms. There are a total of 600,000 total beds nationwide which include the 200,000 in single purpose facilities according to the Assisted Living Federation of America. Table 48 is a list of the top 30 providers as of December 31, 1999. There are slightly more than 157,000 beds in more than 200 residences. If the Assisted Living Federation numbers are correct, the providers are serving about a quarter of the total beds nationwide.

Table 48 Thirty largest assisted living chains as of December 31, 1999

Company	Headquarters location	Total assisted living with assisted living beds	Locations with assisted living	Percent occupancy	Number of states with assisted living
Alterra Healthcare Corp.	Milwaukee, WI 53118	20,653	450	80	27
Emeritus Assisted Living	Seattle, WA 98121	13,400	130	86	29
Marriott Senior Living Services	Washington, DC 20058	11,603	144	N/A	29
Sunrise Assisted Living	McLean, VA 22102	10,906	140	96	23
Atria Retirement and Assisted Living	Louisville, KY 40202	10,415	109	N/A	26
CareMatrix Corp.	Needham, MA 02494	7,400	61	N/A	14
ARV Assisted Living	Costa Mesa, CA 92626	7,192	58	N/A	N/A
Assisted Living Concepts	Portland, OR 97220	7,148	185	75	16
Capital Senior Living Corp.	Dallas, TX 75240	6,100	36	N/A	18
Summerville Senior Living	Alexandria, VA 22312	6,000	48	N/A	N/A
Advocat	Franklin, TN 37067	5,215	54	N/A	N/A
Merrill Gardens	Seattle, WA 98102	5,123	53	87	14
Manor Care	Toledo, OH 43604	4,236	45	N/A	10
Senior Lifestyle Corp.	Chicago, IL 60601	4,127	46	92	16

Complete Care Services	Horsham, PA 19044	3,506	28	95	4
EdenCare Senior Living Services	Alpharetta, GA 30004	3,480	41	91	7
Leisure Care	Bellevue, WA 98005	3,463	32	94	9
Regent Assisted Living	Portland, OR 97204	2,867	29	94	9
Encore Senior Living	Portland, OR 97220	2,625	42	82	9
Sun Healthcare Group2	Albuquerque, NM 87109	2,582	36	77	8
The Adult Care Group	Clearwater, FL 33759	2,462	18	90	2
Life Care Services	Des Moines, IA 50309	2,433	53	93	19
Greenbriar Corp.	Addison, TX 75001	2,382	30	85	10
Genesis Health Ventures3	Kennett Square, PA 19348	2,264	32	85	9
Extencicare Health Services	Milwaukee, WI 53203	1,912	45	79	11
Hallmark Senior Communities	Towson, MD 21204	1,750	16	88	2
Americare Properties	Sikeston, MO 63801	1,699	42	93	3
Life Care Centers of America	Cleveland, TN 37312	1,696	40	N/A	22
Prestige Care	Vancouver, WA 98661	1,428	22	75	7
Castle Senior Living	Summitt, NJ 07901	1,182	10	80	2

Source: "Top 30 Assisted Living Chains," *Provider*, Washington, DC, July 2000. Note: not all companies that received surveys returned them, including American Retirement Corp.

Nursing homes provide long-term care for elderly residents. This includes daily pharmaceutical services, social, recreational/exercise, and medical supplies. Many offer sub-acute care that is more intensive for patients whose conditions are more serious than a traditional nursing home. This is a lower cost alternative than general acute care that is the service of a formal, fully staffed hospital.¹⁵⁹ In 1999, there were 18,000 nursing homes with 1.9 million beds and 1.6 million residents. In recent years, the nursing home industry has been plagued by bankruptcy and concerns about the quality of care. One of the difficulties is that there are large numbers of small operators who are undercapitalized.

A trend in senior housing is to provide living arrangements that range from independent living in standalone units, to assisted living, and then to continuing care. In addition to private non-profit organizations, there are a number of well capitalized for-profit firms that are getting into this business. Table 49 lists the top 50 owners in 2002. Some of these firms specialize in an area like assisted living while others offer a broader range of living arrangements. Much like the situation in the office sector where there are firms

¹⁵⁹ American Hospital Association, 2002

that specialize in property management, there are also firms that specialize in managing senior housing.

Table 49 Top 50 owners of senior housing

2001 Rank	Rank 2002	Organization	Headquarters City	State	Number of units	Number of locations
1	1	Colson & Colson/Holiday Retirement Corp.	Salem	OR	29,951	252
5	2	Nationwide Health Properties, Inc.	Newport Beach	CA	14,704	162
20	3	Senior Housing Properties trust	Newton	MA	11,737	48
3	4	Sunrise Assisted Living, Inc.	McLean	VA	10,973	166
2	5	Alterra Healthcare Corporation	Milwaukee	WI	10,074	201
6	6	Brookdale Living Communities, Inc.	Chicago	IL	9,642	53
7	7	Atria, Inc.	Louisville	KY	8,460	83
--	8	Erickson Retirement Communities, LLC	Baltimore	MD	8,371	8
4	9	Health Care REIT, Inc.	Toledo	OH	8,349	135
10	10	Health Care Property Investors, Inc.	Newport Beach	CA	8,201	94
12	11	Marriott Senior Living Services	Washington	DC	7,049	56
11	12	Classic Residence by Hyatt/Encore Senior Living	Chicago	IL	6,663	48
13	13	ACTS Retirement-Life Communities, Inc.	West Point	PA	6,152	16
--	14	Evangelical Lutheran Good Samaritan Society	Sioux Falls	SD	6,016	102
14	15	Merrill Gardens	Seattle	WA	5,836	56
15	16	Capital Senior Living	Dallas	TX	5,505	39
19	17	First Centrum, LLC	Sterling	VA	5,372	88
--	18	Emeritus Assisted Living	Seattle	WA	5,279	61
22	19	Assisted Living Concepts, Inc.	Portland	OR	4,976	128
17	20	Leisure Care, Inc.	Bellevue	WA	4,838	33
23	21	National Benevolent Association	St. Louis	MO	4,439	13
--	22	Covenant Retirement Communities	Chicago	IL	4,412	15
24	23	Fountains Continuum of Care, Inc.	Tucson	AZ	4,388	16
--	24	LTC Properties, Inc.	Oxnard	CA	4,200	89

2001 Rank	Rank 2002	Organization	Headquarters City	State	Number of units	Number of locations
16	25	American Retirement Corporation	Brentwood	TN	4,189	21
--	26	Retirement Housing Foundation	Long Beach	CA	4,122	19
--	27	Horizon Bay Management, LLC	Chicago	IL	4,068	25
25	28	Hearthstone Assisted Living, Inc.	Houston	TX	3,792	32
--	29	Simpson Housing Solutions, LLP	Long Beach	CA	3,497	40
--	30	Kisco Senior Living	Carlsbad	CA	3,399	20
18	31	GFB-AS Investors, LLC	Jericho	NY	3,333	23
--	32	Life Care Retirement Communities, Inc.	Des Moines	IA	3,299	9
--	33	Southern Assisted Living, Inc.	Chapel Hill	NC	2,949	42
--	34	Healthcare Realty trust, Inc.	Nashville	TN	2,909	37
--	35	The Shelter Group	Baltimore	MD	2,904	29
--	36	USA Properties Fund, Inc.	Roseville	CA	2,789	18
--	37	American Baptist Homes of the West	Pleasanton	CA	2,772	11
--	38	American House Senior Living Residences	Bloomfield Hills	MI	2,764	27
--	39	Front Porch Communities and Services	Burbank	CA	2,403	12
--	40	Justus Rental Properties, Inc.	Indianapolis	IN	2,387	7
--	41	Presbyterian Manors of Mid-America, Inc.	Wichita	KS	2,255	17
8	42	Senior Lifestyle Corporation	Chicago	IL	2,191	17
--	43	Metro National Corp.	Houston	TX	2,190	6
--	44	Carefree Holdings, LP	Las Vegas	NV	2,170	9
--	45	Life Care Services, LLC	Des Moines	IA	2,163	13
--	46	Asbury Services, Inc.	Gaithersburg	MD	2,138	4
--	47	EdenCare Senior Living Services, L.P.	Alpharetta	GA	2,125	27
--	48	George M. Leader Family Corp.	Hershey	PA	2,030	10
--	49	FountainGlen Properties	Newport Beach	CA	1,963	9
--	50	John Knox Village	Lee's Summit	MO	1,963	1

Source: American Seniors Housing Association, <http://www.seniorshousing.org/misc/50owners.aspx>, originally found in the National Real Estate Investors, October 2002.

Changes in the way healthcare is delivered that will influence buildings

Total U.S. healthcare expenditures are expected to increase from \$1.31 trillion in 2000 to \$2.6 trillion in 2010. By 2010, health spending as a share of gross domestic product is estimated to increase from 14.0 percent to 16.2 percent.¹⁶⁰

The concept of managed care has created an abundance of organizations in the healthcare community. Two dominant types are HMOs (Health Maintenance Organizations) and PPOs (Preferred Provider Organizations). The managed care provider promises that its members will seek care from a fixed group of providers and in return, the provider promises to deliver the health care needed for the group's members at pre-negotiated prices.

Table 3 illustrates the percentage of Managed Care Organizations (MCOs) operating in the largest metropolitan statistical areas in the United States. This table illustrates the extent to which managed care has penetrated the market in the last decade.

Table 50 Managed care penetration in major MSAs (July 2002)

MSA name	Number of managed care organizations (MCO) marketing in area	Average number of plans per MCO	Total population	Population enrolled in managed care in MSA	Percent of Population in Managed Care
Atlanta	11	3.36	4,262,584	2,491,697	58%
Austin-San Marcos	14	3.71	1,313,231	302,622	23%
Baltimore	15	2.67	2,592,945	1,124,983	43%
Boston-Worcester-Lawrence	16	4.38	6,997,089	2,387,047	34%
Buffalo-Niagara Falls	8	3.88	1,162,917	846,862	73%
Charlotte-Gastonia-Rock Hill	13	4.46	1,544,944	649,713	42%
Chicago-Gary-Kenosha	16	3.25	9,233,053	2,784,190	30%
Cincinnati-Hamilton	11	4.45	1,994,521	344,176	17%
Cleveland-Akron	17	4.18	2,942,641	1,514,793	51%
Columbus	12	4.25	1,559,597	822,461	53%
Dallas-Fort Worth	14	3.71	5,400,467	1,869,153	35%
Denver-Boulder-Greeley	14	4	2,653,476	891,907	34%
Detroit-Ann Arbor-Flint	23	2.7	5,478,262	3,501,871	64%
Houston-Galveston-Brazoria	14	3.64	4,795,974	1,870,316	39%
Indianapolis	13	2.92	1,632,452	641,441	39%
Jacksonville, FL	11	4	1,131,490	500,924	44%
Kansas City, MO	12	4.42	1,803,445	1,459,478	81%
Las Vegas	11	3.82	1,660,516	534,168	32%
Los Angeles-Riverside-	20	3.7	16,700,693	9,108,387	55%

¹⁶⁰ Source: Centers for Medicare and Medicaid Services, Office of the Actuary, National Health Statistic Group, Section 1. p. 23., June 2002

Orange County					
Miami-Fort Lauderdale	19	3.89	3,958,243	1,740,444	44%
Milwaukee-Racine	14	3.5	1,692,074	662,901	39%
Minneapolis-St. Paul	11	3.91	3,015,573	1,490,807	49%
New Orleans	10	4.4	1,332,694	286,992	22%
New York-Northern New Jersey-Long Is- land	42	3.45	20,959,919	11,201,944	53%
Norfolk-Virginia Beach- Newport News	11	3.91	1,583,170	747,488	47%
Orlando	14	4.29	1,707,175	740,035	43%
Philadelphia- Wilmington-Atlantic City	15	4.4	6,215,629	3,583,045	58%
Phoenix-Mesa	16	3.69	3,383,644	1,684,144	50%
Pittsburgh	8	4	2,347,163	1,466,320	62%
Portland-Salem	15	3.67	2,317,384	727,219	31%
Sacramento-Yolo	13	4.08	1,874,683	1,210,141	65%
Salt Lake City-Ogden	10	2.9	1,348,606	194,354	14%
San Antonio	10	4.6	1,626,538	772,511	47%
San Diego	12	4.75	2,862,819	1,760,523	61%
San Francisco- Oakland-San Jose	23	3.3	7,073,361	3,284,986	46%
Seattle-Tacoma- Bremerton	15	4.13	3,605,124	985,397	27%
St. Louis	11	3.55	2,617,637	1,605,198	61%
Tampa-St. Petersburg- Clearwater	14	4.43	2,450,337	1,204,676	49%
Washington, DC	22	2.86	5,166,839	3,531,500	68%
West Palm Beach- Boca Raton	17	3.94	1,165,049	534,528	46%

Source: Health Industry Market Intelligence Database

HMOs and PPOs have been a catalyst for shifting services from onsite acute care to off-site, sub-acute care.¹⁶¹ These changes have led to:

- A greater focus on the long-term benefits of preventive care
- Sub-acute hospitals that offer convalescent care at greatly reduced daily costs compared to acute care general hospitals
- "Alternate site" care such as outpatient surgery performed in ambulatory surgery centers
- In-home transfusions and other home care instead of in-clinic care to save money
- Rehabilitation services that permit injured workers to return to work more quickly
- The merging of hospital companies into mega-firms that have buying clout.

As a result, many existing hospitals have been closed, downsized, or partly converted to sub-acute care, nursing homes, and other new or more cost-effective uses. The total

¹⁶¹ *Health Care Industry Trends & Market Analysis*. Plunkett Research, Ltd., 2001-2003

number of investor-related hospitals is declining due to an over abundance of beds and low occupancy that depress operating margins. Between 1996 and 1999, Tenet Healthcare closed approximately 12 percent of its hospitals.

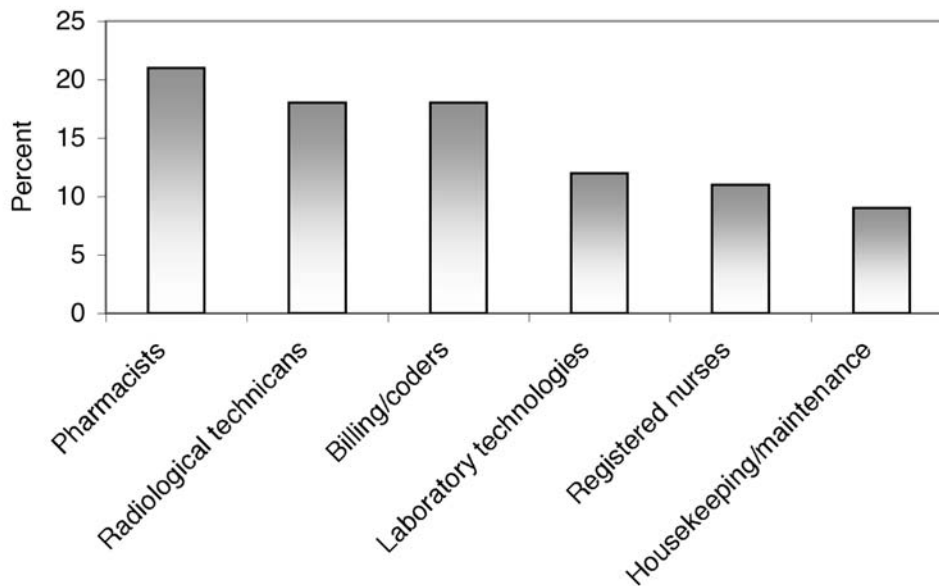
The number of acute care hospitals is declining as consolidation activity among for-profit and tax exempt chains continues to rise. The reason for consolidation probably has more to do with operating efficiency than economies of scale. Larger enterprises have more weight and power with industry suppliers, insurance companies, and the government.

Large chains find it difficult to leverage their networks over a broad geographical basis. Decentralized local operations appear to result in better operating efficiency and cost-effectiveness.

The industry is shifting from institutional settings (i.e., hospitals) to more home care and individualized centers. This trend will continue to gain momentum with an aging population. Home based services are expected to grow and eventually outpace total healthcare spending in the future.

Hotel chains are leveraging their experience and operational knowledge to build and operate assisted living facilities. Private operators of assisted living centers are not likely to have the capital to compete effectively.

The nursing home category of the healthcare facilities industry is increasingly converting to sub-acute care beds where the operating margins are better. In addition, they may increase margins further by offering ancillary services for patients.



Source: US Hospital Vacancies, Selected Jobs Categories-2001

Figure 98 Percent of job vacancies in healthcare industry by type

Labor costs are also a driver of these changes. A shortage of qualified, pharmacists, registered nurses, and therapists is increasing hospital costs. According to a 2001 study, there were 168,000 unfilled positions in hospitals.¹⁶²

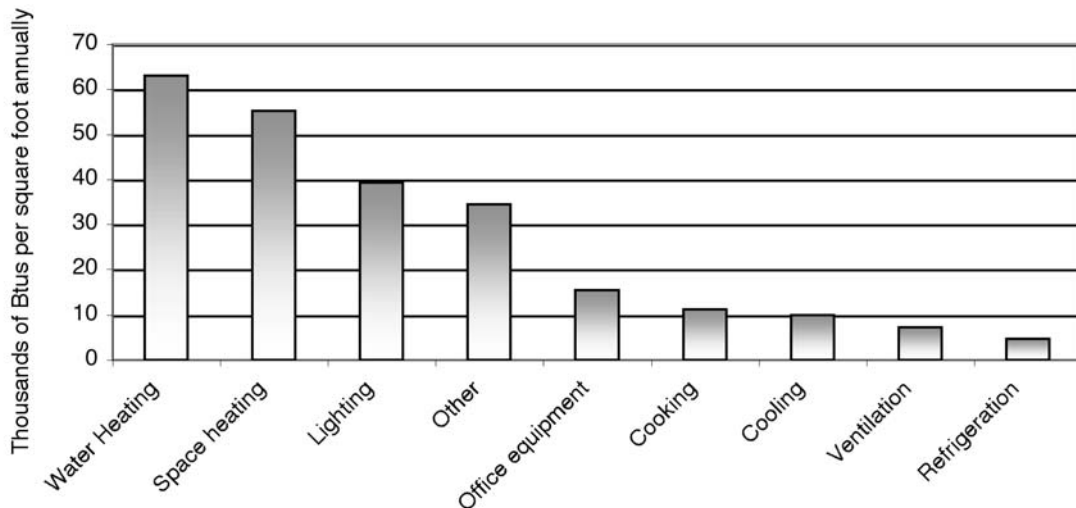
New construction trends

Total spending for health care construction was \$18.6 billion in 2000, up 6.4 percent from 1999. Analysts predicted that overall healthcare construction activity would grow by about seven percent in 2002.

The healthcare industry has many small undercapitalized firms. The healthcare facilities industry is facing tighter capital standards that have put a cap on new build-out rates for most companies. Some companies have developed innovative financing arrangements to continue their growth initiatives. For example, Sunrise Assisted Living has instituted a sell/manage-back strategy that allows them to sell mature properties and secure long-term management contracts that provide a steady flow of revenue. Sunrise also retains an interest in the communities that allows them to share in the operating results. Sunrise currently has 25 properties under construction and another 40 under development.¹⁶³

Energy end-use intensities and energy using equipment in the healthcare sub-market

Figure 99 shows the 1995 energy use intensities for the inpatient sub-market. If space heating, cooling, and ventilation are combined, then the most intensive energy use is space conditioning. That is followed by water heating and lighting.



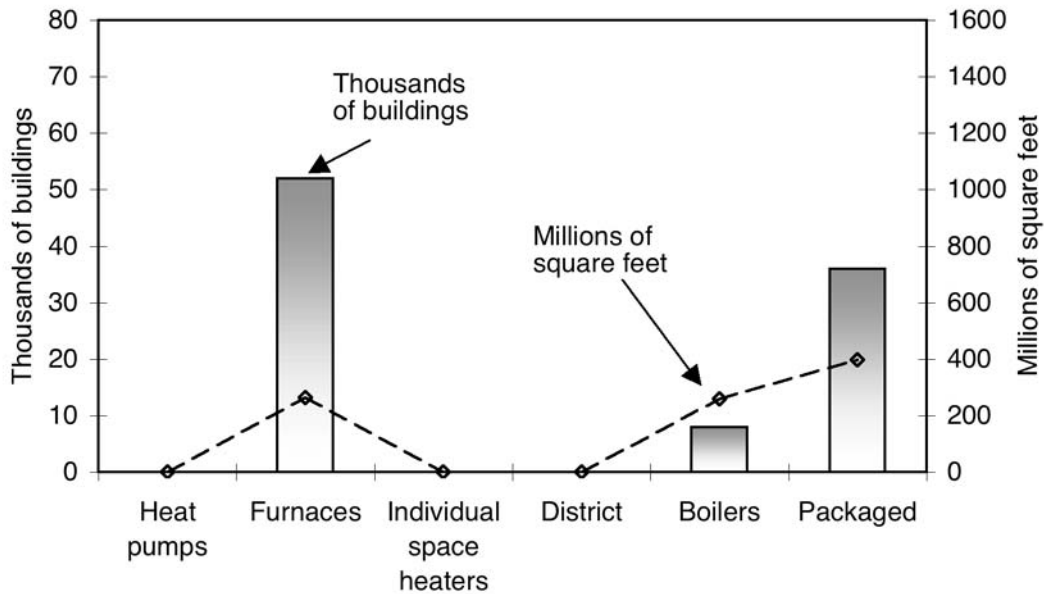
Source: EIA, CBECS, Table EU4, 1995

Figure 99 End-use energy intensities in the healthcare sub-market

¹⁶² The Hospital Workforce Shortage: Immediate and Future, TrendWatch, June 2001

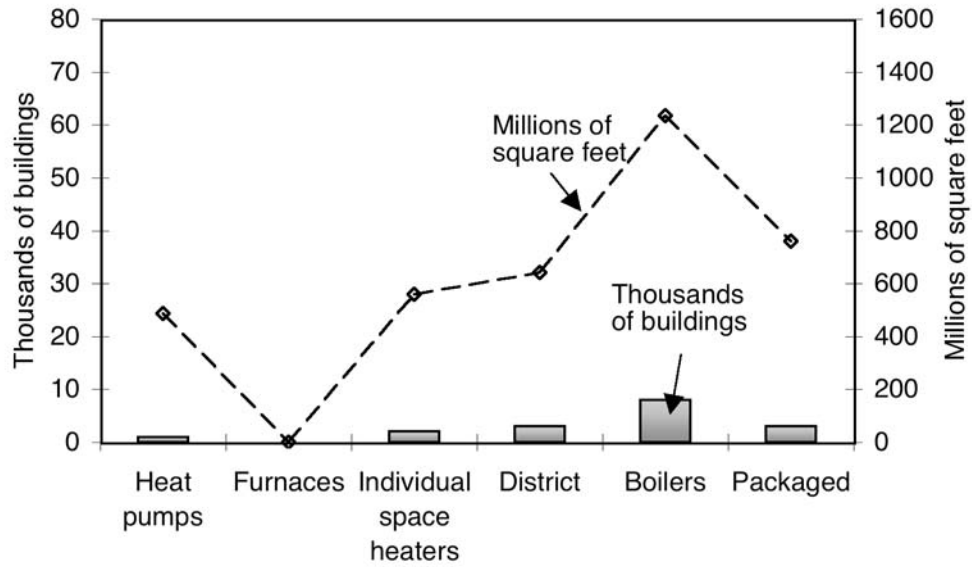
¹⁶³ Building, Design and Construction, 3/1/2002

There are marked differences in the types of equipment energy end-uses in the inpatient and outpatient markets. In the healthcare market, all the buildings and floor space are heated. Figure 100 and Figure 101 illustrate the differences in heating equipment. In the outpatient sub-market, most of the buildings are heated by furnaces and to a lesser extent by packaged units. In terms of the square footage of buildings, packaged units are the most common followed by boilers and then furnaces. This probably indicates a pattern of larger buildings heated by packaged units with smaller buildings heated by furnaces. In inpatient facilities boilers and to a certain extent district heating systems heat a substantial amount of space. Packaged units are also present.



Source: EIA, CBECS 1999 Tables B32-33

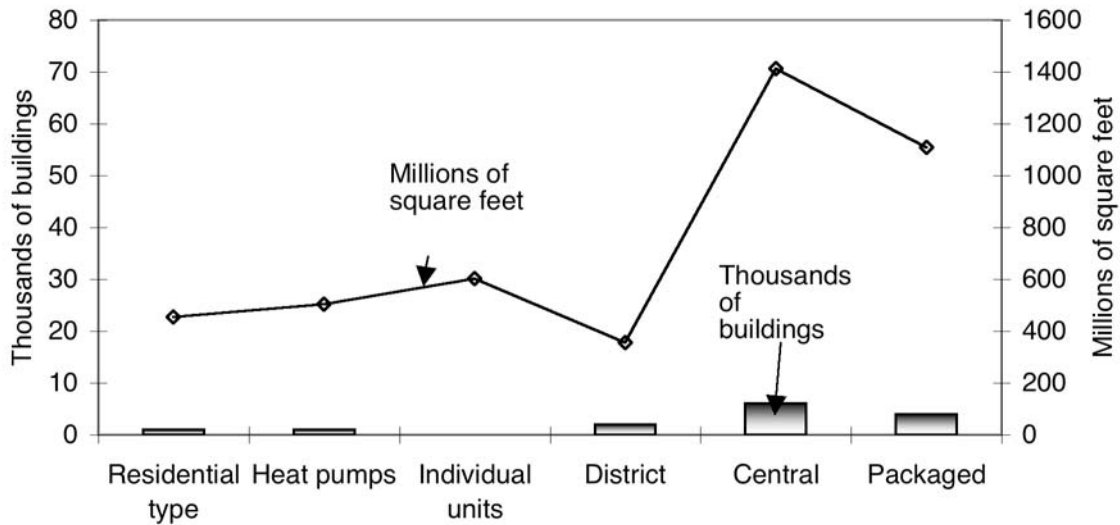
Figure 100 Types of heating equipment in outpatient facilities



Source: EIA, CBECs 1999 Tables B32-33

Figure 101 Types of heating equipment in inpatient facilities

The data for cooling are somewhat difficult to interpret. The data for outpatient buildings is not robust enough to interpret. For inpatient buildings, most buildings and buildings with the most square feet have central cooling systems. There is also some district cooling probably reflecting the campus-like nature of some inpatient settings. There is also substantial use of packaged units. Heat pumps, individual cooling units, and residential style cooling are also found in buildings representing substantial amounts of square footage. Many of these units are likely being used as supplemental units. Many hospitals, especially older ones, have had a number of additions over the years and there are often multiple systems that have been installed during the construction of the various additions.



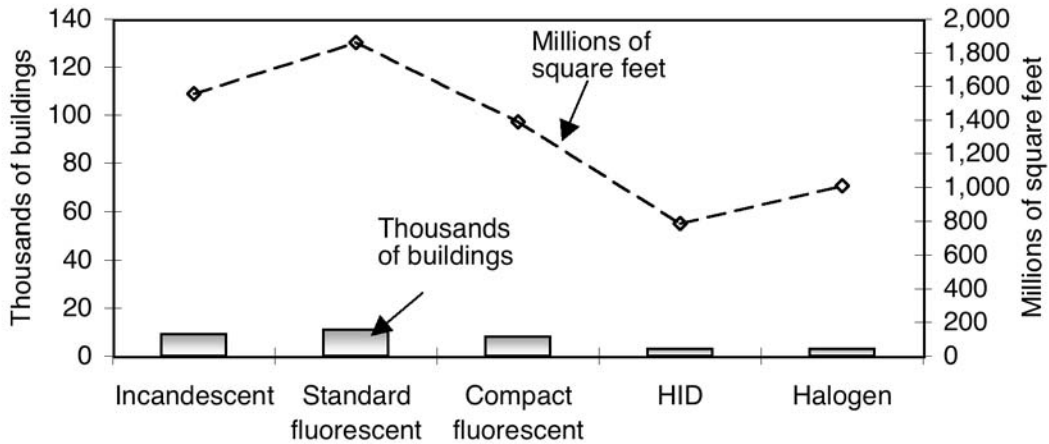
Source: EIA, CBECS 1999 Tables B34-35

Figure 102 Types of cooling equipment in the inpatient facilities

Incandescent lamps are found in buildings representing 83 percent of inpatient floor space and 66 percent of outpatient floor space, respectively (Figure 103 and Figure 104). Standard fluorescent fixtures are found in buildings representing 100 percent of the floor space for inpatient buildings and 97 percent of floor space for outpatient buildings. Electronic ballasts are found in buildings representing 89 percent of the floor space for inpatient care and 69 percent of the outpatient care. This would indicate that there has been substantial penetration of efficient fluorescent lighting into both the inpatient and outpatient sub-markets although we do not know if all areas of the buildings with electronic ballasts actually use electronic ballasts.

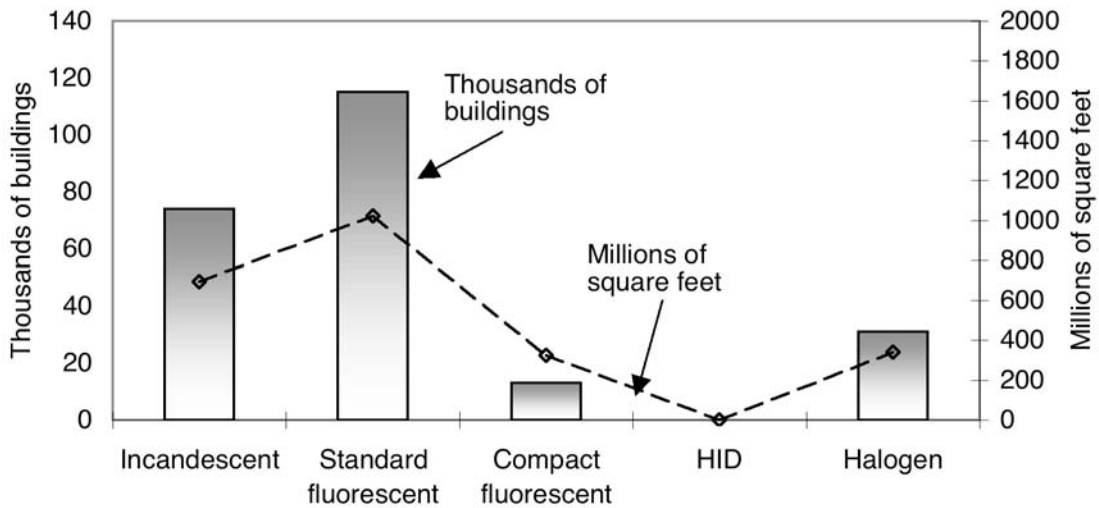
Buildings representing 74 percent of the inpatient floor space have CFLs compared to 31 percent of the buildings representing outpatient floor space. Buildings with 54 percent of the inpatient floor space have some halogen bulbs compared to 32 percent of the floor space for the outpatient part of the market. Buildings with 42 percent of the floor space have some HID lighting but information about inpatient settings is not available.

The bottom line with respect to lighting is that incandescents are still widely used, but it appears that efficient linear fluorescent lighting has penetrated the market as a whole. The indications are that the inpatient sub-market has made greater strides in this area than the outpatient market.



Source: EIA, CBECS 1999 Tables B38-39

Figure 103 Types of lighting in inpatient facilities

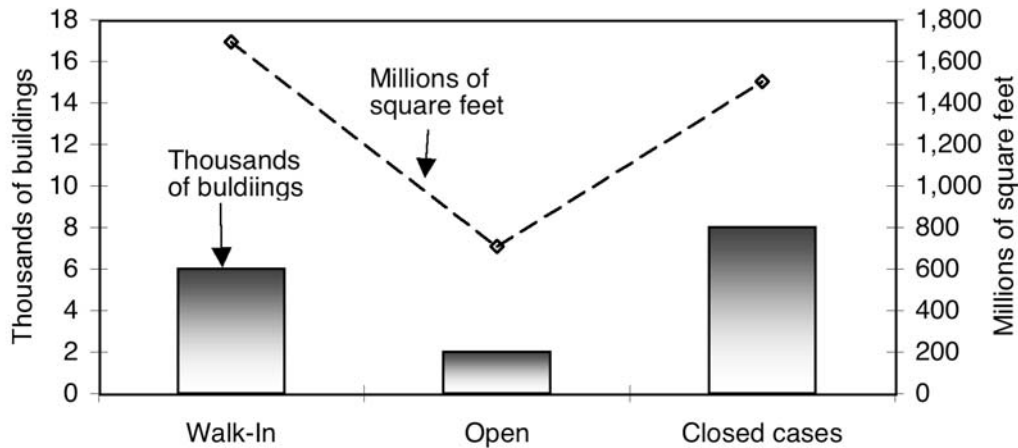


Source: EIA, CBECS 1999 Tables B38-39

Figure 104 Types of lighting in outpatient facilities

Estimates of refrigeration equipment are available for the in-patient but not the outpatient sector. Buildings accounting for 94 percent of the inpatient floor space have refrigeration equipment. Given the 1.9 million square feet of floor space in the in-patient sub-market, it appears that 80 percent or more of inpatient buildings have walk-in or closed case refrigeration (Figure 105).

Finally, we did examine the presence of energy management systems. Buildings representing 89 percent of the inpatient floor space and 36 percent of the outpatient floor space have energy management systems. Thus, energy management systems are available in most of the inpatient buildings.



Source: EIA, CBECS 1999 Table B36

Figure 105 Types of refrigeration equipment in inpatient facilities

Summary and conclusions

There are about 100,000 buildings containing approximately three billion square feet of floor space in the healthcare sub-market. The health care sub-market is divided into the inpatient and outpatient markets. This division of the market is important for three reasons. In terms of square footage, the inpatient market (1.9 billion square feet) is larger than the outpatient market (1.1 billion square feet). However, there are 10 times as many buildings in the outpatient market as in the inpatient market. The second is that energy use intensities in the inpatient market are three to four times the energy intensities in the outpatient market. Thirdly, the long-term trend is for services to move from the inpatient to the outpatient market. Thus, in future years, the inpatient market is likely to continue to shrink while the outpatient market will grow.

There is some concentration of ownership in the inpatient market but not to the same degree as we have seen in other commercial building markets. In general, the market is made up of a mix of public and private and profit and not-for-profit ownership. There are large systems with numerous buildings and there are many smaller community hospitals, some of which are independent and some of which are banding together in small numbers in an effort to survive.

One of the key trends in this market is the movement from inpatient services to outpatient services. One of the drivers of this has been the formation of health management organizations to contain costs and deliver healthcare outside of the inpatient structure. Another driver of the movement from inpatient to outpatient services has been advances in equipment, treatment, and medicines which have made it possible to deliver medicine outside the hospital setting. Diagnostic equipment is becoming smaller and patients can be trained to use it. Surgery has become less invasive making it practical to provide many forms of surgery in outpatient settings. Advanced medicines make it possible to treat patients in offices. What this seems to mean is that while there will still be a need

for acute care facilities, the number and scale of these facilities will continue to diminish. It also means that care will increasingly be delivered in office type settings.

Outpatient care includes nursing home and assisted living care. Historically, nursing and assisted living care have been provided by small local independent operators. Many of these operators are now leaving the business because they are undercapitalized and because of the focus on standards and quality of care. Increasingly, the care for seniors is being assumed by larger, better capitalized organizations that are providing a range of care options from independent living to long-term sub-acute care. One group of players entering this market is lodging companies.

In terms of energy use, it appears that the inpatient market has already done a fair amount with lighting and perhaps other end-use technologies. The outpatient market appears to be less advanced in this regard. One of the difficulties may be that the inpatient market is dealing with older buildings with numerous additions. On several occasions, energy engineers have pointed out that rationalizing systems in addition to using more efficient technologies could save much of the energy in older buildings.

There are some clear strategies for working with players in this market. It is clear that there is a need to work with the larger players in the inpatient market. There are some large national for-profit players but many of the large players are regional and local non-profit organizations. The smallest organizations and the independent players should clearly be dealt with at regional and local levels.

The outpatient market represents an entirely different setting. Much of the care in this sector will be delivered in office settings involving lease space. Thus, the efficiency of this part of the sub-market will depend on what is being done in the office market. The other major part of the outpatient market is the emerging senior housing market. There are really two sets of targets here. The larger, better capitalized players will be building new senior housing. These players will increasingly be national organizations and of course not-for-profit organizations that have long been players in this market. These players may be addressed through larger national strategies. The other group will be the smaller and mostly independent players. This market will have to be addressed at state and local levels.

Chapter 10 Warehouse sub-market

Introduction

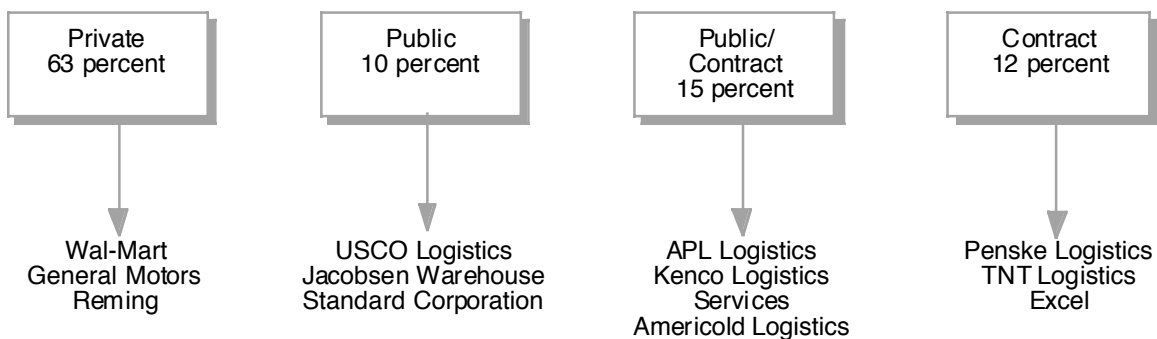
The warehousing sub-market includes industrial warehousing and storage for goods. Many establishments in this sector operate networks with physical facilities, labor forces, and equipment spread over an extensive geographic area.

Warehouses are the critical link to the national supply chain, moving goods from one location to another. Warehouses comprise approximately 12 percent of all commercial buildings in the United States and about 16 percent (10.5 billion square feet) of the total square footage of commercial buildings. Of the 580,000 warehouses in the United States, the majority (92 percent) is privately owned. The remainder is government owned. Non-refrigerated warehouses account for 9.6 billion square feet and refrigerated warehouses about 0.8 billion square feet.

Market composition

Public warehouses can be divided into four sub-markets:

- Public warehouses that are open to the public for use
- Warehouses owned by private owner businesses belonging to large retail, manufacturers, and shipping companies such as Wal-Mart, Home Depot, Lowe's, General Motors, and United Parcel Services
- Contract warehouses that lease space to firms needing warehouse space
- Public/contract warehouses which are a combination of public and contract warehouses



Source: Innovologie, LLC 2003

Figure 106 Percent of square footage belonging to the top 50 players (810.7 million square feet) and top three players by warehouse sub-market

Figure 106 shows a breakdown of the categories of space among the 50 largest firms. The largest portion of this space (63 percent) is private. The balance of the space for the top 50 players is public or contract space or a mix of the two. It is unclear how all warehouse space might be divided among these categories. However, it seems likely that a

very high percentage would be private space used to store goods by manufacturers, retailers, and service companies.

The 50 largest firms (Table 51) manage 810.7 million square feet of space. Combined, the top 50 firms control about eight percent of the total warehouse space in the United States. The top 10 companies account for slightly more than half (51.6 percent) of the total space controlled by the top 50 firms or about 3.7 percent of the U.S. total.

Retailers control most of the warehouse space owned by the top 50. Just as Wal-Mart dominates the retail market, it also dominates the warehouse sub-market. Wal-Mart relies on 150 distribution centers in North America to serve its various retail outlets.

In 2002, nearly two-thirds of the top 50 warehouse companies (60 percent) reported an increase in the amount of warehouse and distribution center space they manage compared to 2001 levels.¹⁶⁴ The major factors driving this increase in square footage were:

- Favorable interest rates
- A glut of available space
- The bust of various dot.com ventures

Table 51 Top 50 warehousing firms in the United States in 2002

2002 Rank	2001 Rank	Company	Headquarters Location	Millions of square feet	Public, Private, or Contract
1	1	Defense Logistics Agency	Fort Belvoir, VA	74.3	Private
2	2	United Parcel Services	Atlanta, GA	70.4	Private
3	3	Wal-Mart Stores*	Bentonville, AR	62.0	Private
4	4	Exel	Westerville, OH	46.7	Contract
5	9	Fleming Co.	Lewisville, TX	32.0	Private
6	6	General Motors	Grand Blanc, MI	23.9	Private
7	7	APL Logistics	Oakland, CA	23.0	Public Contract
8	10	Tibbett & Britten Group NA*	Etobicoke, Canada	22.0	Public
9	5	Kmart*	Troy, MI	20.0	Private
9	14	Target Stores	Minneapolis, MN	20.0	Private
11	11	AmeriCold Logistics	Atlanta, GA	19.0	Public Contract
12	8	Sysco	Houston, TX	18.2	Private
13	23	TNT Logistics North America	Jacksonville, FL	16.2	Contract
14	13	Kenco Logistics Services	Chattanooga, TN	16.0	Public Contract
14	15	JC Penney	Plano, TX	16.0	Private

¹⁶⁴ Reed Business Information, a division of Reed Elsevier Inc. 2002

2002 Rank	2001 Rank	Company	Headquarters Location	Millions of square feet	Public, Private, or Contract
14	16	Genco Distribution	Pittsburgh, PA	16.0	Private
17	12	USCO Logistics	Hamden, CT	15.0	Public
18	16	W.W. Grainger, Inc.	Lake Forest, IL	14.0	Private
19	18	National Distribution Centers - NFI	Vineland, NJ	13.1	Public Contract
20	21	DSC Logistics	Des Plaines, IL	13.0	Private
20	26	Penske Logistics	Reading, PA	13.0	Contract
22	28	Ozburn-Hessey Logistics	Nashville, TN	12.4	Public Contract
23	19	Warehouse Specialists	Appleton, WI	12.3	Public Contract
23	21	Daimler Chrysler	Center Line, MI	12.3	Private
25	26	Ford Motor Company	Livonia, MI	11.5	Private
26	20	United Stationers	Des Plaines, IL	10.9	Private
27	25	Caterpillar Inc.	Morton, IL	10.4	Private
28	23	Standard Corp.	Columbia, SC	10.2	Public
29	30	Ace Hardware	Oak Brook, IL	8.8	Private
30	29	Lowe's Companies	Wilkesboro, NC	8.6	Private
31	34	Big Lots	Columbus, OH	8.0	Private
31	35	Menlo Logistics	Redwood City, CA	8.0	Contract
31	40	Jacobson Warehouse	Des Moines, IA	8.0	Public
34	32	Tru-Serv Corp.	Chicago, IL	7.9	Private
35	31	USF Logistics	Long Grove, IL	7.5	Contract
36	42	Metro Canada Logistics	Laval, Canada	7.0	Public Contract
37	42	Saddle Creek	Lakeland, FL	6.4	Public Contract
38	38	CS Integrated	Liberty Corner, NJ	6.4	Public
38	42	Millard Refrigerated	Omaha, NE	6.4	Public
40	41	TJX Companies*	Framingham, MA	6.1	Private
41	N/A	WOW Logistics	Appleton, WI	6.0	Public
41	37	Service Craft LLC	Buena Park, CA	6.0	Public Contract
43	46	Sweetheart Cup	Owings Mills, MD	5.9	Private
44	36	Xerox*	Webster, NY	5.8	Private
45	32	Army & Airforce Exchange	Dallas, TX	5.5	Private

2002 Rank	2001 Rank	Company	Headquarters Location	Millions of square feet	Public, Private, or Contract
46	48	Logisco	Nashville, TN	5.1	Public
47	N/A	Fastenal Logistics	Winona, MN	5.0	Public Contract
48	49	Limited Brands Logistics Services	Columbus, OH	4.9	Private
49	50	Circuit City	Richmond, VA	4.8	Private
50	46	CVS Pharmacy	Woonsocket, RI	4.7	Private

Source: Reed Business Information, a division of Reed Elsevier Inc. 2002

Some warehousing companies specialize in refrigerated storage. Table 52 lists the top 20 warehousing companies in the United States providing this service. Note that the space is identified in cubic feet rather than square feet. Therefore, we cannot determine the total percent of square feet owned by these 10 companies.

Table 52 Leading refrigerated warehouse companies in the United States

2002 Rank	2001 Rank	Company	Location	Millions of cubic feet
1	1	AmeriCold Logistics	Atlanta, GA	437.3
2	2	Millard Refrigerated Services	Omaha, NE	196.8
3	3	CS Integrated	Liberty Corner, NJ	149.3
4	4	Atlas Cold Storage	Toronto, Ontario	123.8
5	5	United States Cold Storage	Cherry Hill, NJ	105.7
6	7	P & O Cold Logistics	Dominguez Hills, CA	69.7
7	6	Versacold Group	Vancouver, British Columbia	56.7
8	8	Nordic Cold Storage	Atlanta, GA	47.7
9	9	Columbia Colstor	Moses Lake, WA	43.1
10	10	Interstate Warehousing	Fort Wayne, IN	39.3
11	11	Burris Refrigerated Logistics	Milford, DE	38.0
12	13	Henningsen Cold Storage	Hillsboro, OR	36.0
13	12	Total Logistic Control	Zeeland, MI	34.3
14	N/A	The Preferred Group	Jersey City, NJ	30.0
15	15	Hanson Cold Storage	Benton Harbor (Sodus), MI	27.8
16	14	Zero Mountain	Fort Smith, AR	23.6
17	16	Cloverleaf Cold Storage	Sioux City, IA	23.4
18	18	Interstate Cold Storage	Fort Wayne, IN	21.4
19	17	Geneva Lakes Cold Storage	Darien, WI	19.4
20	19	Richmond Cold Storage	Richmond, VA	19.2

Source: International Association of Refrigerated Warehouses, Reed Business Information, a division of Reed Elsevier Inc. 2002

Changing market conditions

Many manufacturers, distributors, and retailers are recognizing that they are not specialists in logistics and that they can best serve their customers by focusing on their core business. They want goods and components arriving at just the right moment rather than being stored until needed. They want goods moving to the customer and not to warehouses or storage facilities. Thus, manufacturers are outsourcing what occurs at both ends of the production line to logistics companies. The result is that there is a blurring of the line between manufacturing and logistics.

Electronic commerce and the Internet are a factor in these trends. The staff of *Warehousing Management*, summarizing a conference on the future of warehousing, point out that online ordering is so immediate that customers have come to expect their orders will be tracked and delivered flawlessly and speedily. Some retail customers have come to expect multiple shipments a day in order to minimize stock on hand.¹⁶⁵

To meet these needs warehouse executives are trying new methods. Competitors are partnering with each other. The bottom line is that supply chains are being made flexible at the same time that they are being compressed, that is, disruption to the flow of goods is being minimized.¹⁶⁶

The warehouse of the future

One way that warehouses are adapting to the needs of customers is to change the way they are designed. To meet the new demands, warehouse operators will either have to construct new facilities or adapt existing facilities.

To be successful, the warehouse of the future will have to provide value added services. Warehouses will change their design from that of *holding* facility to *transfer* facility.¹⁶⁷ This has a number of implications for warehousing. Among other things, it means an increase in automated processing equipment that will increase the energy intensity of the warehouse. The introduction of automated equipment and transitional processing of products may increase the importance of controlling the warehouse environment.

Warehouse operators are considering flow-through or cross-docking facilities that have goods entering one side of the warehousing, being reconfigured, and then leaving the other side. Reconfiguration activities might involve, for example, combining a monitor, a CPU, software, and manuals to form a complete computer shipment for the end-use customer. Changes to packaging, quality testing, and post-production modifications to equipment are other examples of reconfiguration and transitional processing. According to a recent survey conducted by the University of Arizona in Tempe, "high-performance warehouses cross-dock 50 percent or more of incoming goods and set targets of 25 to 50 turns per year."¹⁶⁸

¹⁶⁵ Staff, "Preparing for an e-world," *Warehousing Management*, September 1, 2000.

¹⁶⁶ *Ibid.*

¹⁶⁷ Harrington, L. "Digital Age Warehousing," *Industry Week*, online article.

¹⁶⁸ Arnold Maltz as cited in *Ibid.*

Harrington¹⁶⁹, citing the Maltz study, says that flow-through or cross docking will result in:

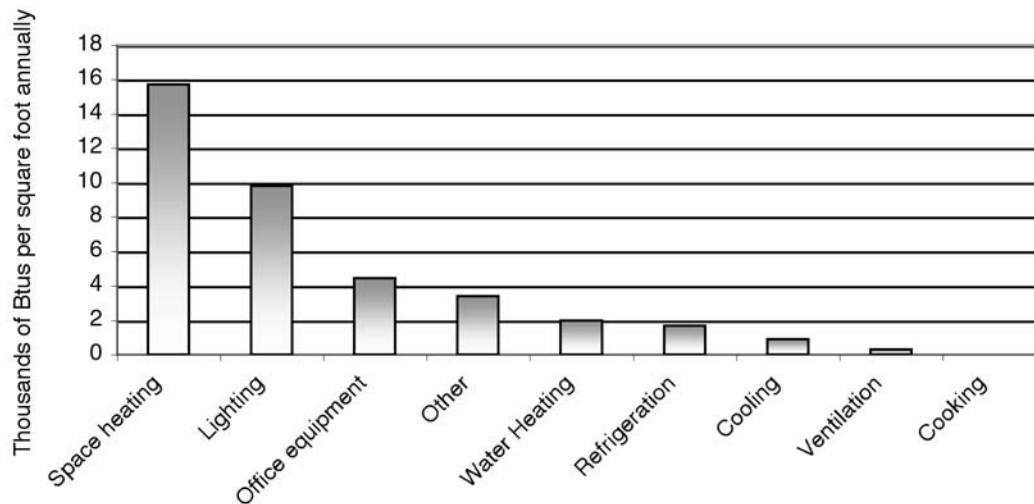
- Narrower warehouses
- Fewer square feet per door
- Larger parking lots to accommodate trailers being left for loading operations
- An 18 percent increase in the cost per square feet of warehousing

Increasing demands for new and complex warehousing tasks has increased the importance of warehouse management systems.¹⁷⁰ These computer programs are the “brains” of the warehouse, managing and monitoring all tasks.¹⁷¹

"I think a lot of the future of warehousing is about transformation management," concludes Robert Auray Jr., president and CEO of USCO Logistics, in Naugatuck, Connecticut. "This transformation management could be anything from coordinating and sequencing the inbound flow of parts to a production line, to managing a consolidation center filled with consignment inventory that supplies a network of retail stores with just-in-time merchandise, to customizing product to final customer orders."¹⁷²

Energy intensity and energy end-use technologies

According to CBECS, space heating is the most energy intensive end-use in the warehouse sub-market (Figure 107). Lighting is the second most intensive use. The energy



Source, DOE EIA "A Look at Commercial Buildings in 1995: Characteristics, Energy Consumption, and Energy Expenditures, Oct. 1998, Tables EU-2, p. 311

Figure 107 Energy end-use intensities in the warehouse sub-market

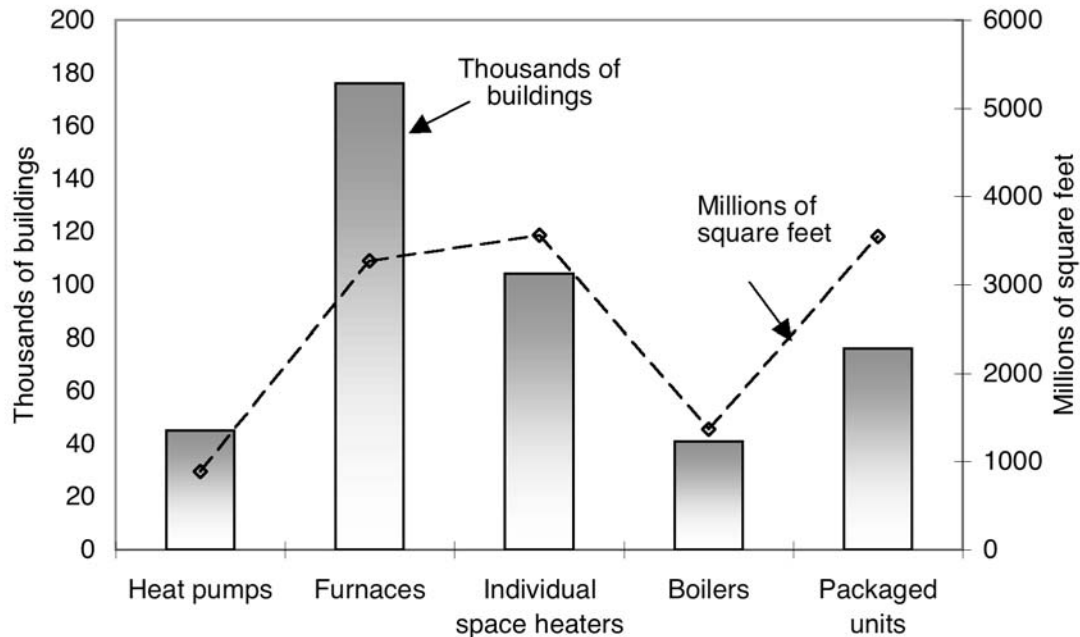
¹⁶⁹ *Ibid.*

¹⁷⁰ Staff, "How third-party logistics providers are using IT to improve performance," *Warehousing Management*, October 1, 2002.

¹⁷¹ Harrington, L. "Digital Age Warehousing," *Industry Week*, online article.

intensity for cooling and ventilation are quite minimal compared to energy intensity for these uses in other commercial sub-markets.

Buildings representing approximately three-quarters of all warehouse floor space are heated (77 percent). The equipment (Figure 108) used to heat the floor space includes packaged units (44 percent), individual space heaters (44 percent), and furnaces (40 percent). Obviously, some buildings have more than one type of heating equipment.



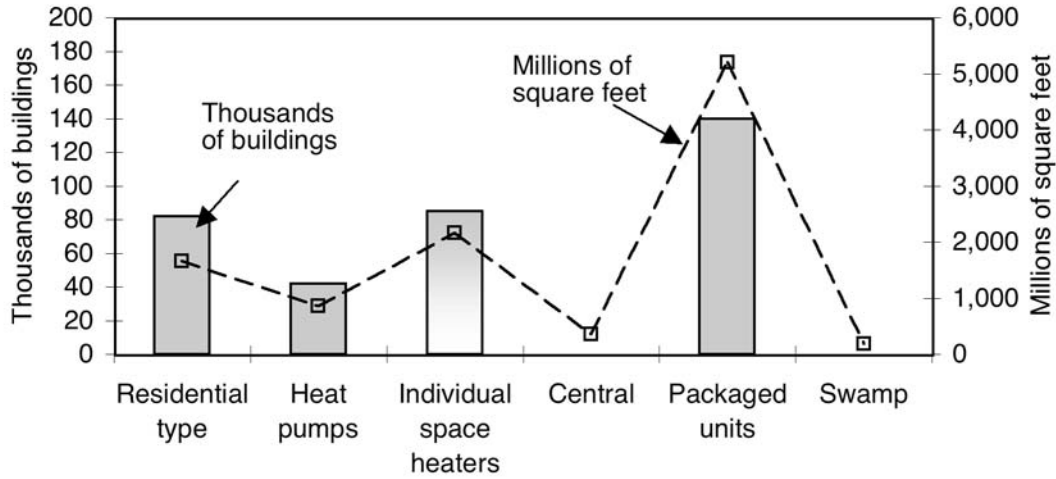
Source: EIA, CBECS 1999 Tables B33-34

Figure 108 Types of heating equipment used in the warehouse sub-market

Slightly more than one-half (51 percent) of all warehouse buildings have cooling equipment. Buildings with 73 percent of the floor space have cooling. This suggests that cooling is most likely to be found in larger buildings. Packaged units cool the majority (68 percent) of this floor space (Figure 109).

Sixty-eight percent of all warehouse buildings representing 89 percent of the total floor space have lighting. Standard fluorescent fixtures are found in buildings accounting for 88 percent of the total floor space in non-refrigerated warehouses and in buildings accounting for 100 percent total refrigerated warehouse space. Electronic ballasts are found in buildings accounting for 63 percent of the total space in non-refrigerated warehouses. These data suggest that efficient linear fluorescents have penetrated about 72 percent of the eligible space. HID fixtures are used for light buildings representing 42 percent of the total floor space.

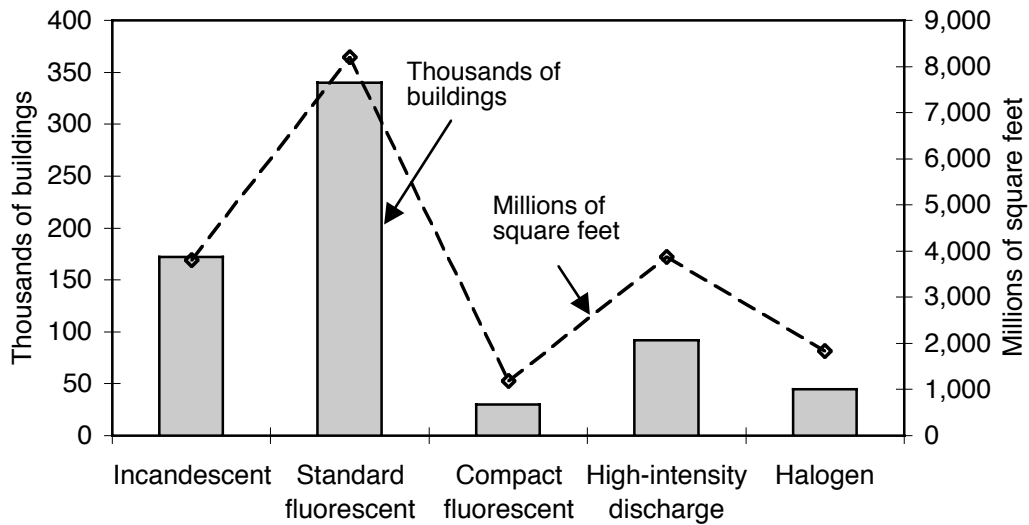
¹⁷² *Ibid.*



Source: EIA, CBECS 1999 Tables B34-35

Figure 109 Types of cooling equipment installed in the warehouse sub-market

Slightly more than one-third of warehouse facilities (34 percent) have water heating equipment. Two-thirds of these facilities (62 percent) rely on central water heating systems while the remainder relies either on distributed (35 percent) or a combination of equipment (four percent).



Source: EIA, CBECS 1999 Tables B38-39

Figure 110 Types of lighting equipment in the warehouse sub-market

Skylights are a good option for warehouses where lighting intensities are not required to be high. Based on CBECS data, warehouses accounting for about 35 percent of non-refrigerated warehouse space have skylights.

Summary and conclusions

This chapter describes the warehouse sub-market. As in other markets, we found a few large players with a large amount of floor space. The smallest of the top 50 large players has about four million square feet of warehouse space. Thus, there are likely to be many other players with large amounts of space. We suspect that most of this is private space used to store goods rather than public or contract space.

There are also some large players who provide cold storage. We may begin to see an increase in the amount of cold storage in response to some of the trends in the food sales and food services industry such as the growth in eating-out, take-out, the demand for convenience foods, and the movement to larger food sales operations.

One of the key findings in this chapter is that the role of warehousing is changing. Suppliers, manufacturers, and retailers are working to compress the supply chain, that is, reduce the amount of time that goods are in the chain. Suppliers, manufacturers, and retailers are also attempting to reduce the amount of inventory that is in place. The goal is to have just the goods in place that are needed. This means that increasingly, the delivery of goods is time critical.

The functions of warehouses are changing as well. Historically, warehouses were used as a way station for goods until they were needed. Warehouses are now becoming logistics centers. Warehouses are adding value to products by serving as locations where components of product may be brought together, where quality testing may be completed, where goods may be repackaged before moving on. Warehouses are also serving as centers for sorting and dealing with returned merchandise.

Food sales is an area where we see warehouses becoming processing centers. The food warehouses currently process meat onsite. Grocery chains are doing similar things with their distribution centers.

Warehouses are being redesigned to accommodate both the speed and flexibility that manufacturers and consumers require. This shift in operations is resulting in new warehouse designs such as narrower square footage between doors, larger parking for trucks, improved information technology to monitor inventory flows, and the expansion beyond “traditional” warehousing functions to goods processing. An important implication of this is that energy intensity in warehouses may begin to rise and/or warehouses may begin to morph into facilities that do not manufacture goods but process goods.

One thing that is clear is that logistics is becoming an increasingly important discipline. More and more manufacturers and retailers are focusing on their core businesses and outsourcing the movement of their goods to logistics companies. The alternative is to develop the in-house logistics expertise.

The energy intensity of warehouses is low, less than 40,000 Btus per square foot annually. However, these data are now about eight years old. Many of the changes in logistics that we have seen have occurred in the last eight years. Thus, we may see a rise in energy intensity. Space heating and lighting are the main energy uses in warehouses.

Chapter 11 The Education Sub-Market

Introduction

The education sub-market consists of 327,000 buildings that have more than 8.65 billion square feet. Fifty-eight percent were built before 1970 and the median age is more than 35.5 years. Sixty percent of the buildings are government buildings and about 40 percent are nongovernment buildings. Of the government buildings, about 43,000 or 22 percent are state buildings and 151,000 or 78 percent belong to local governments. Nongovernment buildings, of which there are approximately 133,000, include private schools, colleges, and universities. Eight percent of those buildings are owner occupied. The status of the remaining 92 percent of nongovernment educational establishments is unclear.

For convenience, we have divided the market into the K-12 market, the post-secondary market, the private for-profit market, and the virtual educational market.

The K-12 Market

The K-12 market includes both public and private facilities. There are about 121,000 K-12 schools (Table 53). The number of public buildings (93,273) is more than three times the number of private education buildings. Most of the buildings are regular schools although the private sector contains a larger percentage of other types of structures. There are more than 14,000 school districts in the public sector.

It is no surprise that most K-12 schools are found in the urban fringe and large towns (Table 54). Private schools are about 30 percent Catholic, 49 percent other religious, and 22 percent non-sectarian. Percentage wise, private schools are more likely to be found in the central city and less likely to be found in rural areas and small towns than are public schools. Private schools may require a large population base for support. Catholic and nonsectarian schools tend to be located in the central city and less so in rural areas. Religious schools are most likely to be found in urban areas. But, when compared to schools other than public schools, there is a higher percent of other religious schools in rural areas and small towns.

Table 53 Type and number of public schools in the United States

	Number of public K-12 schools	Percent of total public K-12 schools	Number of private K-12 schools	Percent of total private K-12 schools
Regular	84,454	91	22,263	82
Special	2,008	2	1409	5
Vocational	1,993	2	-	-
Alternative	4,818	5	1617	6
Montessori			1190	4
Other			739	3
Total	93,273	100	27,218	100

Source: U.S. Department of Education, National Center for Education Statistics, Common Core of Data Survey. This table was prepared July 2002 although the data for the private schools are for 1997, the most recent year available with this breakout.

Enrollment patterns

Enrollment in elementary and secondary schools grew rapidly during the 1950s and 1960s, peaking in 1971. This enrollment rise was caused by the “baby boom” following World War II. From 1971 to 1984, total elementary and secondary school enrollment decreased every year. In 1985, enrollment in elementary and secondary schools started increasing to record levels by the mid 1990s.

Public school enrollment in K-8 schools rose from 29.9 million in fall 1990 to an estimated 33.6 million in fall 2001. Enrollment in high schools rose from 11.3 million in 1990 to 13.6 million in 2001. Public school enrollment is projected to increase every year through 2005.

Approximately 11 percent of all students attend private schools. In 2001, about 5.9 million students were enrolled in private schools at the elementary and secondary levels.

School consolidation has led to the elimination of smaller public schools and a total decline in the number of public schools in the United States (Figure 111). For example, there were 247,000 public schools in 1930 compared to 92,000 in 2000. The decline appears to have ended in the early 1980s when the number of schools began to increase.¹⁷³

There has also been a shift in the structure of public school systems toward middle schools (grades 4, 5, and 6 to 6, 7, and 8). The number of elementary schools rose by 9 percent to 64,000 between 1990-1991 and 1999-2000, but middle schools rose by 35 percent. Meanwhile, the number of junior high schools (grades 7 to 8 and 7 to 9) declined by 22 percent.¹⁷⁴

The average number of students per public school has slowly increased during the past few years, especially among high schools. Meanwhile the average number of students in elementary and middle schools has remained relatively stable. The rising numbers of alternative schools have mitigated the increase in the average size of secondary schools. The average size of regular secondary schools grew from 684 to 785 between 1990-91 and 1999-2000.¹⁷⁵

Table 54 Rural/urban location, percent agency and percent public and private schools

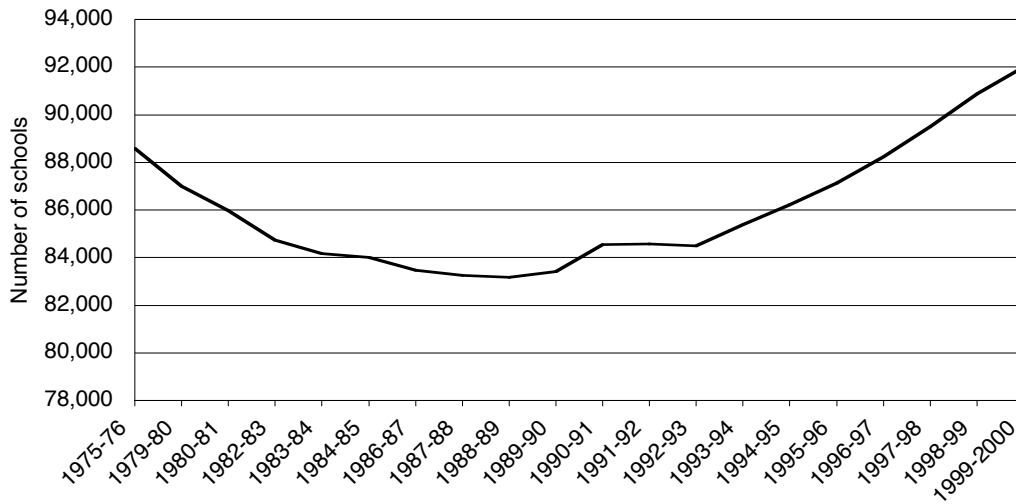
	Central City	Urban fringe and large towns	Rural and small towns	Total percent
Public	24	45	31	100
Private	42	40	18	100
Catholic	46	41	12	99
Other religious	38	39	24	101
Nonsectarian	47	41	12	100

Source: U.S. Department of Education, National Center for Education Statistics. Schools and Staffing Survey (SASS), "Public, Public Charter, and Private School Surveys," 1999–2000. Table 1 and Table 2.

¹⁷³ Digest of Educational Statistics 2002, Chapter 2: Elementary and Secondary Education, National Center for Educational Statistics. http://www.nces.ed.gov/pubs2003/digest02/ch_2.asp#1.

¹⁷⁴ *Ibid.*

¹⁷⁵ *Ibid.*



Source: U.S. Department of Education, National Center for Educational Statistics

Figure 111 Number of schools in the United States from 1975-2000

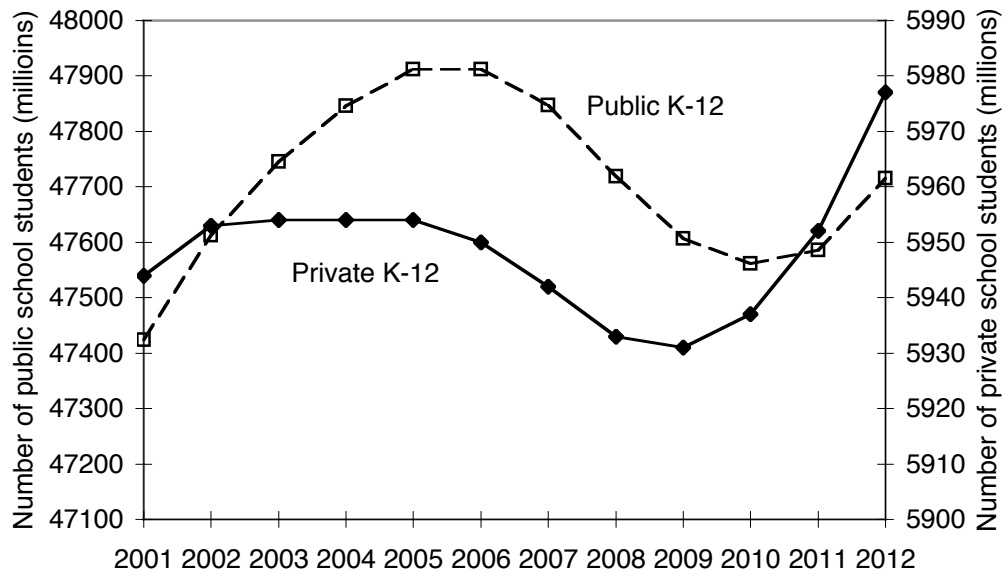
Enrollment projections

According to the U.S. Department of Education, total public and private elementary and secondary school enrollment is projected to increase from 53.2 million in 2000 to 53.9 million by 2005. Total enrollment is projected to decrease to 53.5 million by 2010, followed by an increase to 53.7 million in 2012, resulting in an overall increase of one percent from 2000.¹⁷⁶ Figure 112 shows that the trends in public and private schools are expected to mirror each other although private schools are expected to have a more rapid increase in enrollments between 2008 and 2012.

Between 1999–2000 and 2011–12, the number of public high school graduates is projected to increase 17 percent in the West and 11 percent in the South. Graduates in the Northeast and the Midwest are projected to increase eight percent and one percent, respectively, during the same period.¹⁷⁷ High school graduate rates are expected to increase 9 percent from 2.8 million in 1999–2000 to 3.1 million by 2011–2012.

¹⁷⁶ U.S. Department of Education, National Center for Educational Statistics

¹⁷⁷ *Ibid.*



Source: U.S. Department of Education, National Center for Educational Statistics

Figure 112 Enrollment projections for students in public and private schools

The largest school districts

The 100 largest school districts in the United States have between 45,000 and 100,000 students enrolled. More than 11 million students attend school in these districts. This is just under a quarter of all students (23 percent) enrolled in K-12 schools. New York City Public Schools is the largest public school district, with 1,049,831 students enrolled in 1,218 schools. The second largest is Los Angeles Unified School District, with 735,058 students in 663 schools.

The 100 largest school districts (Figure 113) are substantially larger than most other school districts. In the 2001–2002 school year, 73 percent of all regular school districts had less than 2,500 students while the 100 largest school districts had at least 44,000 students. The 100 largest districts serve an average of 11,686 pupils compared to the remainder of the school districts (about 14,000) that serve an average of 2,831 students.

Sixteen and a half percent of all public school buildings are in these districts. The average school district in the United States and its jurisdictions has 5.6 schools while the 100 largest school districts average 158.4 schools per district.¹⁷⁸

The condition of the buildings in these large districts is not known. Potentially they represent a good target for energy efficiency because the number of actors to be targeted would be relatively few while the buildings are among some of the largest.

¹⁷⁸ U.S. Department of Education, National Center for Education Statistics, “Characteristics of the 100 Largest Public Elementary and Secondary School Districts in the United States: 2001–02” Washington, D.C., U.S. Department of Education Institute of Education Sciences NCES 2003–353.

Figure 113 100 largest school districts in the U.S. ranked by enrollment 2001-2002

School District	City	State	County	Enrollment	Schools
New York City Public Schools	Brooklyn	NY	Kings	1,049,831	1,218
Los Angeles Unified	Los Angeles	CA	Los Angeles	735,058	663
Puerto Rico Department of Education	San Juan	PR	San Juan	604,177	1,538
City of Chicago School District	Chicago	IL	Cook	437,418	599
Dade County School District	Miami	FL	Dade	375,836	363
Broward County School District	Fort Lauderdale	FL	Broward	262,055	244
Clark County School District	Las Vegas	NV	Clark	245,659	275
Houston Independent School District	Houston	TX	Harris	210,950	12,097
Philadelphia City School District	Philadelphia	PA	Philadelphia	197,083	263
Hawaii Department of Education	Honolulu	HI	Honolulu	184,546	279
Hillsborough County School District	Tampa	FL	Hillsborough	169,789	219
Detroit City School District	Detroit	MI	Wayne	166,675	265
Dallas Independent School District	Dallas	TX	Dallas	163,562	226
Fairfax County Public Schools	Fairfax	VA	Fairfax	160,584	198
Palm Beach County School District	West Palm Beach	FL	Palm Beach	160,223	193
Orange County School District	Orlando	FL	Orange	157,433	184
San Diego City Unified	San Diego	CA	San Diego	141,599	182
Montgomery County Public Schools	Rockville	MD	Montgomery	136,895	193
Prince Georges County Public Schools	Upper Marlboro	MD	Prince George's	135,039	196
Duval County School District	Jacksonville	FL	Duval	127,392	178
Gwinnett County School District	Lawrenceville	GA	Gwinnett	116,339	86
Memphis City School District	Memphis	TN	Shelby	115,992	174
Pinellas County School	Largo	FL	Pinellas	114,583	169

School District	City	State	County	Enrollment	Schools
District					
Baltimore County Public Schools	Towson	MD	Baltimore	107,212	170
Charlotte-Mecklenburg Schools	Charlotte	NC	Mecklenburg	106,312	137
Wake County Schools	Raleigh	NC	Wake	101,756	120
Cobb County School District	Marietta	GA	Cobb	98,338	96
Baltimore City Public School System	Baltimore	MD	Baltimore City	97,817	177
Milwaukee School District	Milwaukee	WI	Milwaukee	97,762	208
De Kalb County School District	Decatur	GA	De Kalb	97,501	129
Long Beach Unified	Long Beach	CA	Los Angeles	96,488	90
Jefferson (KY) County	Louisville	KY	Jefferson	93,516	172
Jefferson (CO) County	Golden	CO	Jefferson	88,460	166
Albuquerque Public Schools	Albuquerque	NM	Bernalillo	87,201	138
Polk County School District	Bartow	FL	Polk	81,207	142
Fresno Unified	Fresno	CA	Fresno	81,058	99
Fort Worth Independent School District	Fort Worth	TX	Tarrant	80,597	143
Austin Independent School District	Austin	TX	Travis	77,684	111
Virginia Beach City Public Schools	Virginia Beach	VA	Virginia Beach City	75,970	85
Anne Arundel County Public Schools	Annapolis	MD	Anne Arundel	75,081	119
Mesa Unified District	Mesa	AZ	Maricopa	74,808	89
Jordan School District	Sandy	UT	Salt Lake	73,494	81
Orleans Parish School Board	New Orleans	LA	Orleans	73,185	130
Denver County	Denver	CO	Denver	72,361	134
Cleveland City School District	Cleveland	OH	Cuyahoga	72,199	125
Granite School District	Salt Lake City	UT	Salt Lake	72,082	98
Brevard County School District	Viera	FL	Brevard	71,781	109
Fulton County School District	Atlanta	GA	Fulton	69,841	77
District of Columbia Public Schools	Washington	DC	District of Columbia	68,449	165
Nashville-Davidson County School District	Nashville	TN	Davidson	67,689	123

School District	City	State	County	Enrollment	Schools
Cypress-Fairbanks Independent School District	Houston	TX	Harris	67,562	57
Northside Independent School District	San Antonio	TX	Bexar	66,000	85
Columbus City School District	Columbus	OH	Franklin	64,833	146
Guilford County Schools	Greensboro	NC	Guilford	64,546	101
Mobile County School District	Mobile	AL	Mobile	63,846	102
El Paso Independent School District	El Paso	TX	El Paso	62,844	88
Seminole County School District	Sanford	FL	Seminole	62,786	72
Volusia County School District	Deland	FL	Volusia	62,599	92
Boston School District	Boston	MA	Suffolk	62,141	134
Tucson Unified District	Tucson	AZ	Pima	62,104	121
Santa Ana Unified	Santa Ana	CA	Orange	61,909	54
Greenville County School District	Greenville	SC	Greenville	61,268	94
Lee County School District	Fort Myers	FL	Lee	60,718	78
Arlington Independent School District	Arlington	TX	Tarrant	60,222	75
Davis School District	Farmington	UT	Davis	59,366	83
San Francisco Unified	San Francisco	CA	San Francisco	58,566	113
Washoe County School District	Reno	NV	Washoe	58,532	95
Prince William County Public Schools	Manassas	VA	Prince William	58,017	74
San Antonio Independent School District	San Antonio	TX	Bexar	57,462	104
Atlanta City School District	Atlanta	GA	Fulton	56,586	97
Fort Bend Independent School District	Sugar Land	TX	Fort Bend	56,186	58
San Bernardino City Unified	San Bernardino	CA	San Bernardino	54,166	65
Oakland Unified	Oakland	CA	Alameda	53,545	100
Sacramento City Unified	Sacramento	CA	Sacramento	53,418	79
Aldine Independent School District	Houston	TX	Harris	53,332	65
North East Independent School District	San Antonio	TX	Bexar	53,218	67
Portland School District	Portland	OR	Multnomah	52,908	107

School District	City	State	County	Enrollment	Schools
Chesterfield County Public Schools	Chesterfield	VA	Chesterfield	52,726	59
Pasco County School District	Land O' Lakes	FL	Pasco	52,675	66
Garland Independent School District	Garland	TX	Dallas	52,391	67
East Baton Rouge Parish School	Baton Rouge	LA	East Baton Rouge	52,350	106
Knox County School District	Knoxville	TN	Knox	51,866	89
Cumberland County Schools	Fayetteville	NC	Cumberland	51,434	83
San Juan Unified	Carmichael	CA	Sacramento	51,383	86
Jefferson Parish School Board	Harvey	LA	Jefferson	50,766	85
Elk Grove Unified	Elk Grove	CA	Sacramento	49,970	53
Garden Grove Unified	Garden Grove	CA	Orange	49,809	66
Anchorage School District	Anchorage	AK	Anchorage	49,767	98
Plano Independent School District	Plano	TX	Collin	49,091	64
Wichita	Wichita	KS	Sedgwick	48,852	92
Alpine School District	American Fork	UT	Utah	48,296	58
Clayton County	Jonesboro	GA	Clayton	48,232	49
Minneapolis	Minneapolis	MN	Hennepin	48,155	144
Seattle	Seattle WA	King	47,449	2,652	
Ysleta Independent School District	El Paso	TX	El Paso	46,811	59
Capistrano Unified	San Juan Capistrano	CA	Orange	46,756	49
Howard County Public School System	Ellicott City	MD	Howard	46,257	68
Omaha Public Schools	Omaha	NE	Douglas	45,782	83
Forsyth County Schools	Winston Salem	NC	Forsyth	45,707	68
Caddo Parish School Board	Shreveport	LA	Caddo	44,859	74

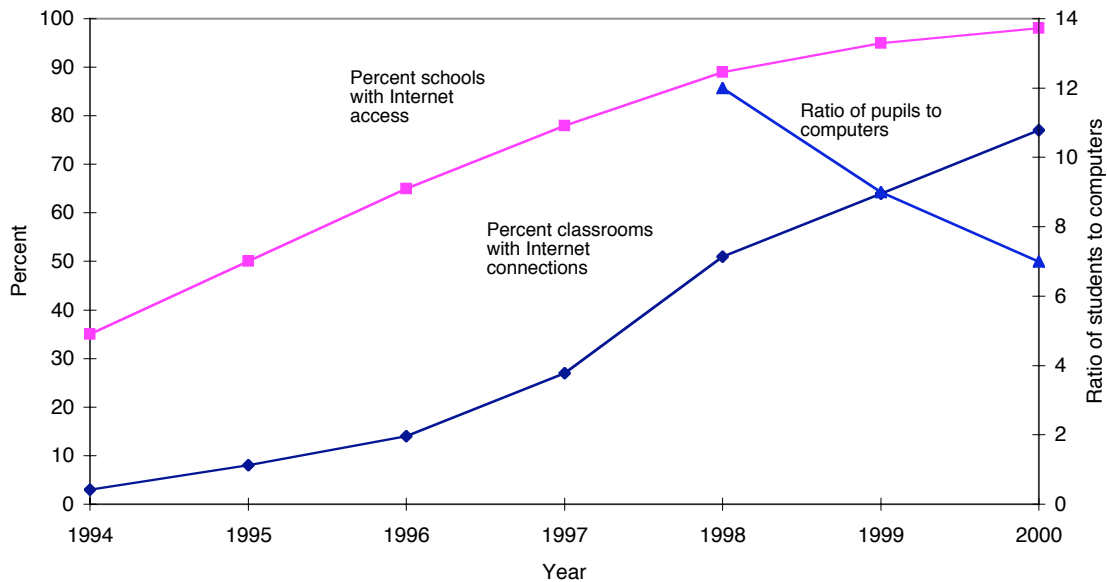
SOURCE: Data reported by states to U.S. Department of Education, National Center for Education Statistics, Common Core of Data, "Public Elementary/Secondary School Universe Survey," 2001-02, Version 1a, and "Local Education Agency Universe Survey," 2001-02, Version 1a.

Uses of technology

Computers are finding widespread use in public school classrooms throughout the United States. Student computer use has increased dramatically since 1993. In 1993, 61 percent of K-12 student and 55 percent of college students were using computers. By 1997, us-

age increased to 70 and 63 percent for K-12 and college students respectively. The most recent report from 2001 indicates that 84 percent of K-12 students and 78 percent of college students using computers. Students at the high school and undergraduate levels are more likely than elementary school children to use home computers for schoolwork.¹⁷⁹

The percentage of schools with Internet connections has risen from 35 percent in 1994 to 98 percent in 2000 (Figure 114). Seventy-seven percent of classrooms had an Internet connection in 2000. Perhaps more importantly from an instructional perspective, the ratio of pupils to computers has declined from 12 students per computer in 1998 to seven students per computer in 2000.



SOURCE: U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System, *Internet Access in Public Schools and Classrooms: 1994-2000*.

Figure 114 Percent of all public schools and instructional rooms having Internet access, and the ratio of students to computers Fall 1994 to Fall 2000

The use of computers in classrooms is evolving very rapidly. Schools built as recently as three years ago incorporated computers into the classroom by placing 3 to 5 computers in space along a wall or by building specialized computer classrooms. At one point, DOE estimated that computers might reduce the student carrying capacity of classrooms by two-thirds resulting in the need for more space and therefore increased energy usage.

There are now several school districts and some states that have or are in the process of instituting laptop initiatives to equip every student with a computer that links wirelessly to the Internet.¹⁸⁰ Further, the rise in the use of photographic and video media is changing the way students produce assignments. The result is likely to be a significant shift in the

¹⁷⁹ U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System, *Internet Access in Public Schools and Classrooms: 1994-2000*.

¹⁸⁰ Henrico County, Virginia is one such school district. There are also districts in North Carolina and California. The State of Maine is equipping middle school students with laptops. The State of Michigan has an RFP for equipping middle school students in Michigan with laptops.

way classrooms are organized and in the way students are taught. These changes are likely to have profound implications for the physical design of school buildings.

It is unclear how these changes will impact energy use in schools. The shift from desktop to laptop units will clearly reduce space requirements, allow more flexibility in organizing space, and reduce the projected increase in energy use that would have resulted from the installation of desktop units.

The rise of the virtual K-12 school

Virtual schools are increasingly becoming a part of the American educational landscape. One definition of a virtual school is an “educational organization that offers K-12 courses through Internet or Web-based methods.”¹⁸¹ Clark estimates that there were as many as 40,000 to 50,000 K-12 students enrolled in virtual schools in the 2001-2002 school year. Virtual schools are provided by a variety of organizations. As of 2002, 14 states were on the process of forming virtual schools. Virtual schools providing supplemental or full curriculums are operated by school districts, universities, state chartered schools, private entities, and others. The data suggest that virtual schools predate 1995 but that the number of such schools has increased rapidly in the last few years. Further, the early virtual schools tended to focus on providing high-school level courses but more recent virtual schools have included elementary and ungraded curricula and many now provide instruction at all K-12 levels.¹⁸²

According to a recent story from the AP Wire services, six such schools serving approximately 1,000 students have been founded in Wisconsin since 2002. These are state chartered schools that have licensed teachers and administer standardized tests. The teachers work with students and parents and are available to provide support by e-mail and telephone. One such teacher, works from her home providing instructional support to 63 students.¹⁸³

It is unclear what impact virtual K-12 schools will have on attendance in schools. Depending on the model or modes that emerge, the impacts may be minimal to substantial. If virtual schools mostly provide supplemental instruction then the impact may not be very great. If large numbers of parents and students elect virtual schooling as an option, virtual schools may impact the need for classrooms and accelerate changes in instruction. Much will depend on how well students “attending” such schools perform. Much will also depend on the availability and willingness of parents and/or others to supervise the education of students. If business and work become increasingly home centered, that may increase the likelihood that education may become home centered as well.

Delivery costs may also influence the trend. A thousand students is about the current median size to which new high schools are built. The cost of such a school is \$17 million. If annual operating and maintenance costs are 10 percent of capital costs, that is \$1.7 million. It may not be long before high growth school districts begin to see the vir-

¹⁸¹ Clark, Tom, *Virtual Schools: Trends and Issues, A Study of Virtual Schools in the United States*. WestEd, Distance Learning Resource Network, October 2001. <http://www.dlm.org/trends.html>.

¹⁸² *Ibid.*

¹⁸³ Williams, Juliet, “Virtual Schools Gain Popularity in Wisconsin,” Washington, DC: *The Washington Post*, January 29, 2004. From the Associated Press.

tual classroom as an alternative to building new schools or using the schools that they have more efficiently.

Trends affecting school energy consumption

There are a number of trends that may lead to changes in energy consumption in the education sub-market. Trends that may have an impact are movement toward:¹⁸⁴

- Longer school hours along with class size reductions and measures to improve student performance. These changes are likely to lead to a rise in energy consumption and energy costs.
- Longer school years and year-round schedules. This will result in school buildings that require cooling in the summer months. The increased hours of annual operation may result in a 15 to 30 percent increase in energy use.
- The "house" or "cluster" concept. The idea is to create smaller school environments by clustering several smaller buildings at larger sites. Cluster based schools may have more specialty classrooms increasing the size of schools resulting in increased energy use. Cluster concepts may result in larger schools overall and may increase transportation fuel use because students may have to be transported greater distances.
- Shared resources such as libraries and cafeterias. These may reduce the need for duplicating facilities and therefore reduce overall energy consumption
- Individualized instruction and the use of computers. These may increase the need for space and therefore the size of buildings. Peripherals, such as printers and scanners that have not been a part of the classroom landscape, may increase energy consumption.

In addition, there are organizations that are encouraging school systems to build green buildings. The State of New Jersey is spending heavily on new schools. Advocates for green buildings in that state have been encouraging their construction. Green buildings are typically energy efficient, but building green does not necessarily result in the most energy efficient buildings.

As of result of the studies of daylighting in schools that were supported by PG&E and completed by the Heschong Mahone Group with support from RLW Analytics, there is increased interest in the use of daylighting in schools.¹⁸⁵

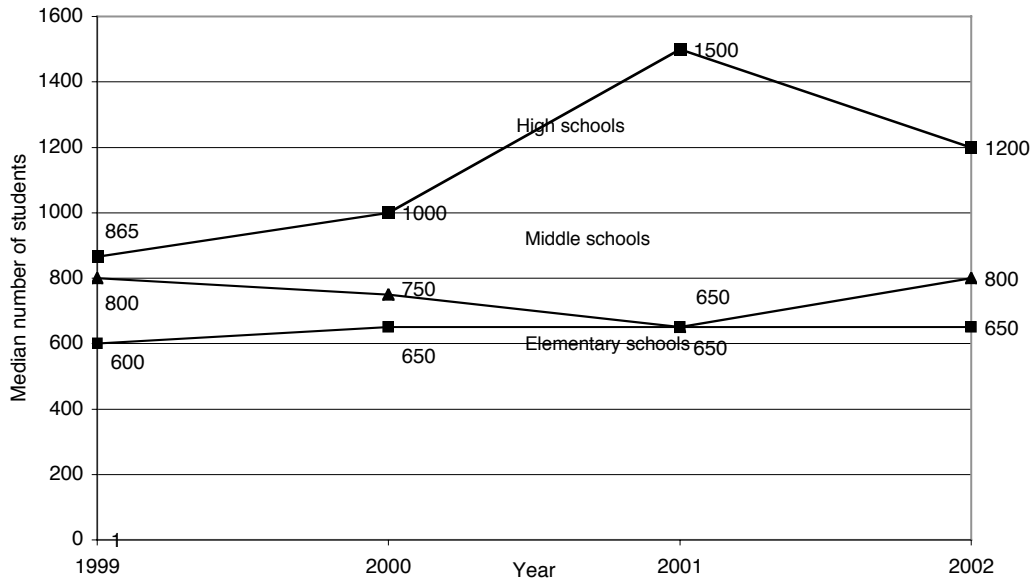
New school construction

The increased demands for both space and equipment are fueling the construction and remodeling activity within the educational segment. In 2002, the average cost per square foot of new construction was \$113 for elementary schools, \$123 for middle schools, and \$119 for high schools. In 2002, the median size of the new schools was 70,000 square

¹⁸⁴ wattwatchers.utep.edu/Assets/fl00Page4.pdf as excerpted from the EnergySmart Schools. website <http://www.eren.doe.gov/energysmartschools>. Some of the items have been modified to reflect new trends or understandings.

¹⁸⁵ http://weblinks.schoolsgogreen.org/links/weblinks_ee_res/00043B6A-007EA7AB-00043B6B.

feet, 105,000 square feet, and 160,000 square feet for elementary, middle, and high schools respectively. The median number of students to be housed in newly constructed elementary and middle schools has remained pretty much constant between 1999 to 2002 but the median size of new high schools has increased during the same period (Figure 115). This may be indicative of the trend toward larger schools.



Sources: School Planning and Management. 2002 Construction Report, February 2002

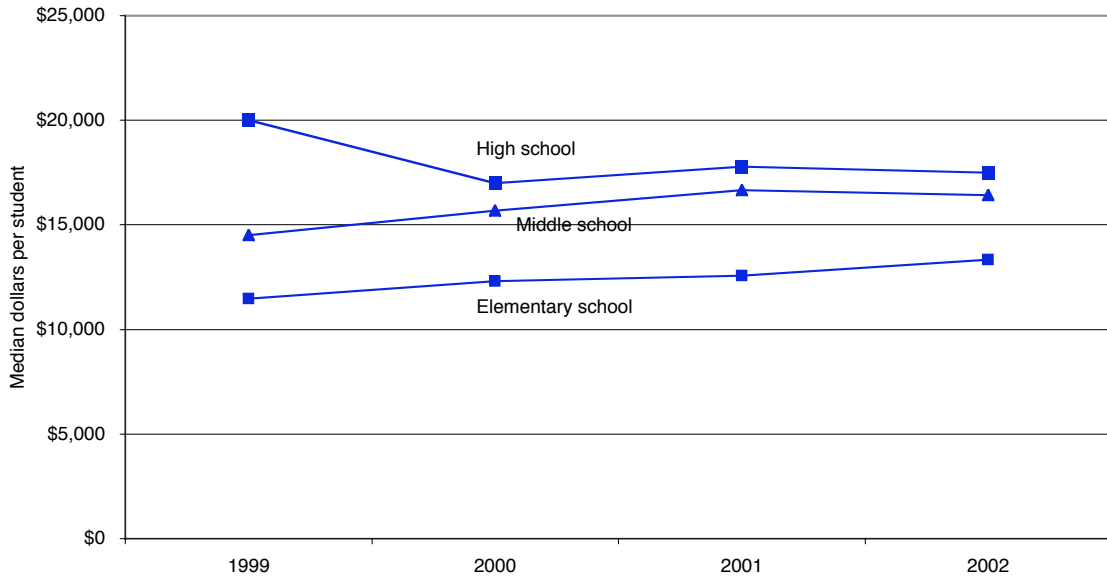
Figure 115 Median design size (number of students) for new schools

In 2002, the median school district spent approximately \$13,333 per student to build an elementary school, \$16,429 per student for a middle school, and more than \$17,500 per student for a new high school (Figure 116). These costs are expected to remain fairly stable during the next few years.¹⁸⁶

New construction projects are expected to be worth approximately \$10.5 billion in 2002 while addition and renovation projects added nearly \$9.4 billion for a total of approximately \$20 billion in construction (Figure 117). Renovations were about \$4.5 billion. Thus, new construction and additions were about three quarters and renovation was about a quarter of the total.¹⁸⁷

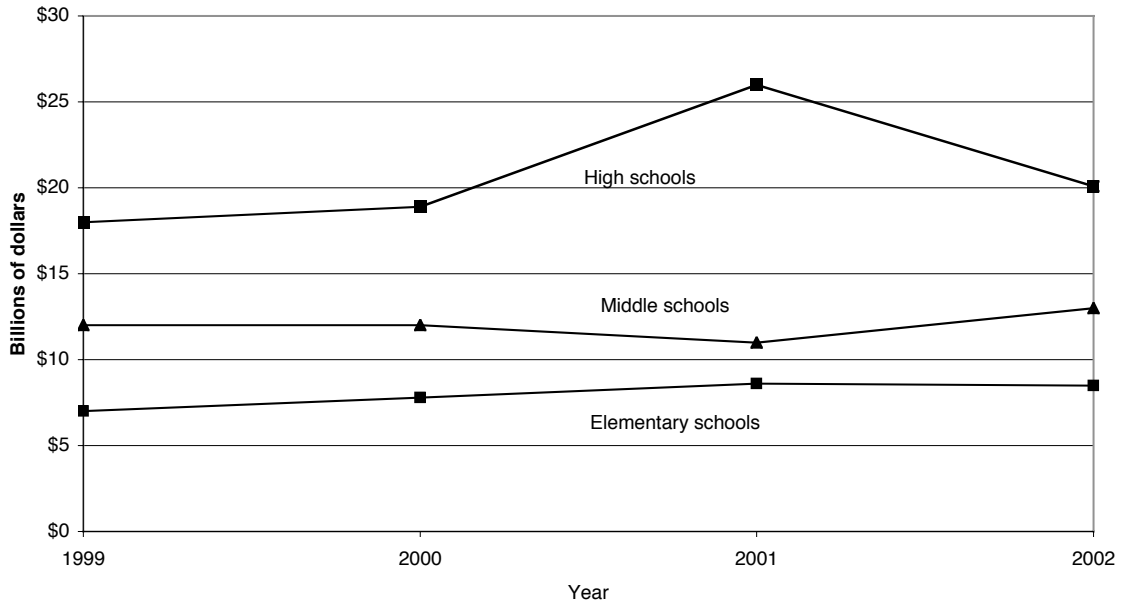
¹⁸⁶ School Planning and Management. 2002 Construction Report, February 2002.

¹⁸⁷ *Ibid.*



Sources: School Planning and Management. 2002 Construction Report, February 2002

Figure 116 Median building costs for public schools



Sources: School Planning and Management. 2002 Construction Report, February 2002

Figure 117 Construction values for schools for selected years in billions of dollars

Post-secondary education

According to the U.S. Department of Education’s National Center for Education Statistics (NCES), 9,632 institutions provide education and/or training beyond the high school

level. The Department of Education further classifies these institutions into those that are Title IV eligible, meaning that they are able to participate in federal student aid programs.¹⁸⁸

The Department of Education also classifies post-secondary institutions by whether or not they are “degree-granting.” Degree-granting status is defined by whether or not they awarded at least one associate’s or higher degree in the previous academic year.¹⁸⁹ Figure 118 shows the distribution of these institutions. Not quite a quarter of these institutions are public. Slightly fewer than 30 percent are nonprofit institutions. The remainder are for-profit institutions. Approximately one half of post-secondary institutions (4,587) are classified as degree granting and eligible for Title IV according to the U.S. Department of Education.

Four-year institutions account for about 29 percent of the total, two-year institutions 29 percent of the total, and for-profit institutions 42 percent.

Seventy-four percent of public institutions, 73 percent of nonprofit, but only 16 percent of for-profit institutions are degree granting.

Of the 1,280 two-year colleges in the United States, 1,171 (91 percent) are community colleges. The majority of all community colleges are public institutions (992) although 148 are privately owned and 31 are under tribal control. Community colleges enroll approximately 10.4 million students.¹⁹⁰

Thirty-five percent of all schools (74 percent of for-profit schools) provide less than two years of instruction and offer vocational or technical training skills to high school graduates.

Enrollment patterns in post-secondary institutions

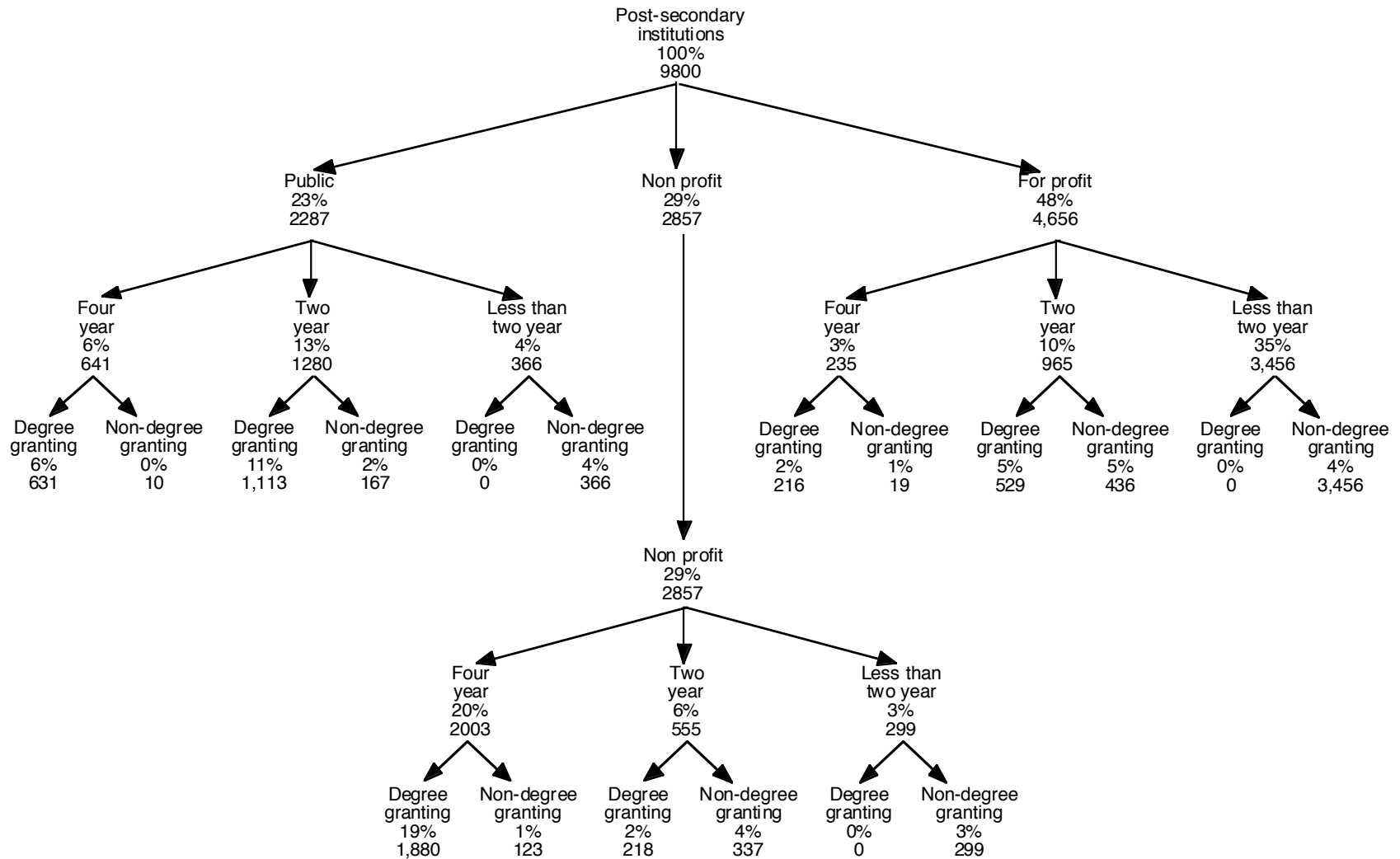
According to the most recent NCES data, enrollment in post-secondary educational institutions has increased and this trend is expected to continue into the next decade (Figure 119). Enrollment in degree-granting postsecondary institutions is projected to increase 15 percent from 15.3 million in 2000 to 17.7 million by 2012.

Between the school years of 1986–87 and 1999–2000, the number of students receiving of associate's degrees increased from 436,304 to 564,933. The number receiving associate’s degrees is projected to be 669,000 by 2011–2012, a further increase of 18 percent. The number of bachelor's degrees awarded annually is expected to increase 16 percent by 2011–2012. By 2012 it is expected that 501,000 will be awarded in 2011-2012, an increase of about 44,000 annually from 1999-2000.

¹⁸⁸ Institutions are eligible to participate in Title IV programs if they are accredited by an agency or organization recognized by the U.S. Department of Education, if they have a program of over 300 clock hours or eight credit hours, if they have been in business for at least two years, and if they have signed a participation agreement with the Office of Postsecondary Education (OPE) in the Department. Eligibility was verified with the OPE’s list of participating institutions for the 1997-98 school year. National Center for Educational Statistics, E.D. tabs, July 1999, p. 1.

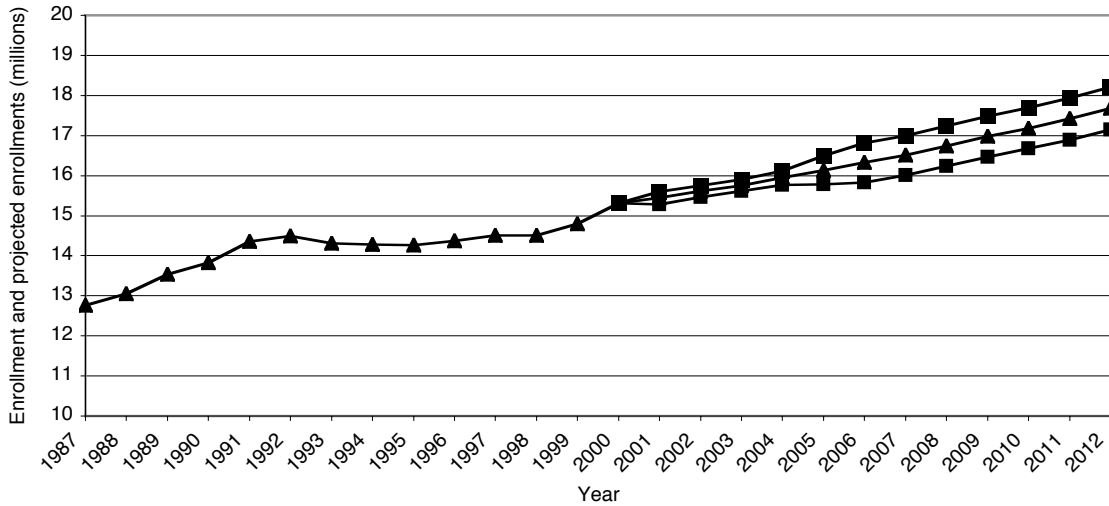
¹⁸⁹ *Ibid.*

¹⁹⁰ Statistics from National Profile of Community Colleges: Trends and Statistics, Third Edition (2000)



Source: Chart developed by Innovologie, LLC., based on data from the U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Institutional Characteristics Survey, 1997-98, p. 5

Figure 118 Percent and number of post-secondary institutions by type of institution and degree granting status



Source: U.S. Department of Education, National Center for Education Statistics: “Fall Enrollment in Colleges and Universities” surveys; Integrated Postsecondary Education Data System (IPEDS) surveys; and Enrollment in Degree-Granting Institutions Model. Originally published as figure 15 on p. 29. The top line with the large squares is the high estimate and the bottom line with the smaller squares is the low estimate.

Figure 119 Enrollment in degree-granting institutions, with alternative projections: Fall 1986 to Fall 2011

Largest colleges and universities in the U.S.

Table 55 lists the 120 largest post-secondary institutions in the U.S. These 120 institutions account for 3.4 million of the roughly 15 million students (slightly more than 20 percent) enrolled in post-secondary institutions in 1999. All but nine are public institutions. Eight of the nine are nonprofits. These include New York University (ranked 15th), Brigham Young University (ranked 26th) and Harvard University (ranked 74th). One, the University of Phoenix that ranks 102nd on the list, is a for-profit institution. We make note of the University of Phoenix, because more recent enrollment figures (cited below) are almost three times the enrollments listed in this table. Ninety-one of these are four-year institutions. Twenty-nine are two-year degree granting institutions.

Table 55 Largest colleges and universities in the United States

Institution	State	Rank	Control	Type	Total Enrollment, Fall 1999
The University of Texas at Austin	TX	1	Public	4 year	49,009
Ohio State University, Main Campus	OH	2	Public	4 year	48,003
Miami-Dade Community College	FL	3	Public	2 year	47,152
University of Minnesota, Twin Cities	MN	4	Public	4 year	45,361
Arizona State University, Main Campus	AZ	5	Public	4 year	44,215
Texas A&M University	TX	6	Public	4 year	43,817

Institution	State	Rank	Control	Type	Total Enrollment, Fall 1999
University of Florida	FL	7	Public	4 year	43,382
Michigan State University	MI	8	Public	4 year	43,038
Pennsylvania State University, Main Campus	PA	9	Public	4 year	40,658
University of Wisconsin, Madison	WI	10	Public	4 year	40,099
Purdue University, Main Campus	IN	11	Public	4 year	39,471
University of Illinois, Urbana	IL	12	Public	4 year	38,851
Houston Community College System	TX	13	Public	2 year	37,882
University of Michigan, Ann Arbor	MI	14	Public	4 year	37,846
New York University	NY	15	Nonprofit	4 year	37,132
Northern Virginia Community College	VA	16	Public	2 year	36,655
University of California, Los Angeles	CA	17	Public	4 year	36,351
Indiana University, Bloomington	IN	18	Public	4 year	36,201
University of Washington, Seattle	WA	19	Public	4 year	35,559
Rutgers University, New Brunswick	NJ	20	Public	4 year	35,308
University of South Florida	FL	21	Public	4 year	34,839
University of Arizona	AZ	22	Public	4 year	34,326
Community College of Southern Nevada	NV	23	Public	2 year	33,402
Florida State University	FL	24	Public	4 year	32,878
University of Maryland, College Park	MD	25	Public	4 year	32,864
Brigham Young University	UT	26	Nonprofit	4 year	32,731
University of Houston, University Park	TX	27	Public	4 year	32,651
University of Central Florida	FL	28	Public	4 year	31,673
Louisiana St. U. & A&M & Hebert Laws Center	LA	29	Public	4 year	31,639
San Diego State University	CA	30	Public	4 year	31,413
University of California, Berkeley	CA	31	Public	4 year	31,347
Florida International University	FL	32	Public	4 year	31,293
Wayne State University	MI	33	Public	4 year	31,025
University of Georgia	GA	34	Public	4 year	30,912
Pima Community College	AZ	35	Public	2 year	30,548
California State University, Long Beach	CA	36	Public	4 year	30,011
College of Du Page	IL	37	Public	2 year	29,032
University of Colorado at Boulder	CO	38	Public	4 year	28,851
University of Iowa	IA	39	Public	4 year	28,846
University of Southern California	CA	40	Nonprofit	4 year	28,766
Boston University	MA	41	Nonprofit	4 year	28,487
Temple University	PA	42	Public	4 year	28,124
North Carolina State University, Raleigh	NC	43	Public	4 year	28,011
City College of San Francisco	CA	44	Public	2 year	27,986

Institution	State	Rank	Control	Type	Total Enrollment, Fall 1999
California State University, Northridge	CA	45	Public	4 year	27,947
Virginia Polytechnic Institute and State U.	VA	46	Public	4 year	27,910
Western Michigan University	MI	47	Public	4 year	27,744
San Francisco State University	CA	48	Public	4 year	27,701
Indiana U. & Purdue U., Indianapolis	IN	49	Public	4 year	27,587
University of Cincinnati, Main Campus	OH	50	Public	4 year	27,467
California State University, Fullerton	CA	51	Public	4 year	27,167
Colorado State University	CO	52	Public	4 year	27,036
San Jose State University	CA	53	Public	4 year	26,937
University of North Texas	TX	54	Public	4 year	26,493
University of Tennessee, Knoxville	TN	55	Public	4 year	26,437
Valencia Community College	FL	56	Public	2 year	26,376
Santa Monica College	CA	57	Public	2 year	26,372
Central Michigan University	MI	58	Public	4 year	26,321
University of Pittsburgh, Main Campus	PA	59	Public	4 year	26,162
Austin Community College	TX	60	Public	2 year	26,135
Iowa State University	IA	61	Public	4 year	26,110
Tarrant County Junior College	TX	62	Public	2 year	25,968
University of Utah	UT	63	Public	4 year	25,781
University of Kansas, Main Campus	KS	64	Public	4 year	25,406
University of California, Davis	CA	65	Public	4 year	25,092
University of Massachusetts, Amherst	MA	66	Public	4 year	25,031
Broward Community College	FL	67	Public	2 year	24,720
University of North Carolina, Chapel Hill	NC	68	Public	4 year	24,653
University of Illinois at Chicago	IL	69	Public	4 year	24,610
California State University, Sacramento.	CA	70	Public	4 year	24,530
University of New Mexico, Main Campus	NM	71	Public	4 year	24,374
SUNY at Buffalo	NY	72	Public	4 year	24,256
Texas Tech University	TX	73	Public	4 year	24,249
Harvard University	MA	74	Nonprofit	4 year	24,214
George Mason University	VA	75	Public	4 year	24,180
University of Oklahoma, Norman	OK	76	Public	4 year	23,694
Northeastern University	MA	77	Nonprofit	4 year	23,556
Virginia Commonwealth University	VA	78	Public	4 year	23,481
University of South Carolina at Columbia	SC	79	Public	4 year	23,430
Georgia State University	GA	80	Public	4 year	23,410
De Anza College	CA	81	Public	2 year	23,264
Oakland Community College, Bloomfield Hills	MI	82	Public	2 year	23,244

Institution	State	Rank	Control	Type	Total Enrollment, Fall 1999
University of Wisconsin, Milwaukee	WI	83	Public	4 year	23,149
University of Kentucky	KY	84	Public	4 year	23,060
Pasadena City College	CA	85	Public	2 year	22,978
Eastern Michigan University	MI	86	Public	4 year	22,956
University of Missouri, Columbia	MO	87	Public	4 year	22,930
Northern Illinois University	IL	88	Public	4 year	22,843
Mount San Antonio College	CA	89	Public	2 year	22,715
El Camino College	CA	90	Public	2 year	22,616
University of Virginia, Main Campus	VA	91	Public	4 year	22,433
Portland Community College	OR	92	Public	2 year	22,401
Southern Illinois University, Carbondale	IL	93	Public	4 year	22,323
Riverside Community College	CA	94	Public	2 year	22,320
West Virginia University	WV	95	Public	4 year	22,315
Mesa Community College	AZ	96	Public	2 year	22,295
University of Nebraska at Lincoln	NE	97	Public	4 year	22,142
Auburn University, Main Campus	AL	98	Public	4 year	22,120
North Harris-Montgomery Community College	TX	99	Public	2 year	22,113
Orange Coast College	CA	100	Public	2 year	21,942
American River College	CA	101	Public	2 year	21,934
University of Phoenix, Southern California	CA	102	For-profit	4 year	21,896
University of Pennsylvania	PA	103	Nonprofit	4 year	21,855
University of Nevada, Las Vegas	NV	104	Public	4 year	21,820
Southwest Texas State University	TX	105	Public	4 year	21,769
Santa Rosa Junior College	CA	106	Public	2 year	21,728
Macomb Community College	MI	107	Public	2 year	21,718
University of Akron, Main Campus	OH	108	Public	4 year	21,687
Kent State University, Main Campus	OH	109	Public	4 year	21,653
Kansas State University	KS	110	Public	4 year	21,543
University of Delaware	DE	111	Public	4 year	21,206
Columbia University in the City of New York	NY	112	Nonprofit	4 year	21,167
Oklahoma State University, Main Campus	OK	113	Public	4 year	21,014
Utah State University	UT	114	Public	4 year	20,865
San Diego Mesa College	CA	115	Public	2 year	20,859
Washington State University	WA	116	Public	4 year	20,799
Salt Lake Community College	UT	116	Public	2 year	20,799
Palomar College	CA	118	Public	2 year	20,492
Illinois State University	IL	119	Public	4 year	20,470
Cerritos College	CA	120	Public	2 year	20,450

Institution	State Rank	Control	Type	Total Enrollment, Fall 1999
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Source: U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), "Fall Enrollment, 1999" survey. This table was prepared September 2001. College and university campuses ranked by Fall 1999 enrollment data.

Trends in post-secondary education

There is evidence that post secondary education is changing, especially in response to the to the increased use of computers, the Internet, and networking. Like the changes influencing the K-12 market, trends in the post-secondary market are changing where education is delivered, when education is delivered, and how education is delivered. The trends will affect both new and existing buildings and whether buildings are built or retained. For example, the dean of a law school in Southern California recently had the window treatments and lighting in the law school buildings redone because of a shift to a computer based laptop centric curriculum. Existing down lighting was entirely replaced with up lighting to reduce the glare on LCD screens.

A recent study identifies the emergence of new types and kinds of post-secondary educational providers.¹⁹¹ These new providers are entering the market rapidly and offering education in new forms. Some examples of the new forms and related institutions are:

- For-profit virtual institutions (e.g., Jones International)
- For-profit institutions with a physical presence as well as virtual offerings (e.g., University of Phoenix)
- Consortia (e.g., Western Governor's University, Southern Regional Electronic Campus, Colorado Community College Online)
- Franchises (e.g., Cardean University)
- For-profit spin-offs of established nonprofit institutions (e.g., NYUOnline).

This study also revealed several emerging trends regarding the types of students and courses offered at these educational facilities.

- While private for-profit institutions enroll only eight percent of all postsecondary students, they enroll 16 percent of all black students, 14 percent of Hispanic students, and four percent of Native American students, according to the U.S. Department of Education.¹⁹²
- In 1990, private career colleges graduated 61 percent of students with degrees in trade and industry while public community colleges graduated 21 percent of those students. That same year, 60 percent of students with degrees in communication technologies

¹⁹¹ The Futures Project: Policy for Higher Education in a Changing World April 2000, Briefing on New Providers.

¹⁹² "A Coming of Age," Community College Week, January 24, 2000.

came out of for-profit institutions while 21 percent graduated from public two-year colleges.¹⁹³

- The average tuition cost is lower at private for-profit than at private nonprofit institutions.
- The University of Phoenix, with campuses in 70 cities and more than 75,000 students, is the largest private university in this country.¹⁹⁴ Jones International University (a for-profit institution) is the first fully online accredited university.¹⁹⁵

For-profit institutions

According to the Education Commission of the States, there are more than 650 for-profit degree-granting institutions. This figure is slightly lower than the 745 institutions that we reported above but the numbers are close. These ventures include:

- Columbia University's for-profit, on-line venture with the New York Public Library, the British Library, the Smithsonian Institution's National Museum of Natural History, the London School of Economics and Political Science, and Cambridge University Press to make their scholarly materials available.¹⁹⁶
- The on-line enrollment of the University of Phoenix, the largest private, for-profit university in the U.S., is now 16 percent of the total and grew almost 60 percent in fiscal 1999.¹⁹⁷
- The Corporate University Xchange reports that the number of corporate universities grew from 400 in the early 1980s to 1,600 in 1999. Furthermore, 40 percent of Fortune 500 companies have a corporate university.
- UNext.com is creating Cardean University, an international endeavor focusing on business education, with the University of Chicago, Stanford, Columbia, London School of Economics, and Carnegie-Mellon (www.cardean.com).
- The University of Maryland University College's for-profit corporation is called UMUC OnLine.com, Inc. Its on-line course enrollments grew from 3,000 in 1997 to 9,000 in 1998 to 21,187 in 1999 to 36,000 in 2000.¹⁹⁸

Virtual institutions

There has also been a surge in institutions offering on-line courses. According to this study, there are more than 900 institutions that offer on-line courses including:¹⁹⁹

¹⁹³ *Ibid.*

¹⁹⁴ University of Phoenix, 2000, <http://www.phoenix.edu/corporate/>. This number is much higher than the number reported in the table above.

¹⁹⁵ Jones International University, 2000, <http://www.jonesinternational.edu/>.

¹⁹⁶ Arenson, Karen W. "Columbia in Web Venture to Share Learning for Profit." *New York Times* 3 April 2000: A22.

¹⁹⁷ Carlson, Scott. "U. of Phoenix Reports 22% Rise in Enrollment." *The Chronicle of Higher Education* October 29, 1999: A56.

¹⁹⁸ Meyer, Eugene L. "U-Md. College Rapidly Expanding Online Education Offerings." *Washington Post* 13 April 2000: M12.

¹⁹⁹ www.futuresproject.org.

- The British government announced the establishment of e-University in February 2000. e-University will be a consortium of public, private, and foreign institutions designed to “compete globally with the major virtual and corporate universities in the United States and elsewhere.”²⁰⁰
- WebCT, a leading provider of on-line course development tools, has provided on-line course support to 24,000 faculty, 90,000 courses, 3.6 million students, and 800 institutions in 45 countries.
- The African Virtual University is a World Bank pilot project offering courses in Sub-Saharan Africa from 14 English and 8 French universities.
- The Global Education Network is proposing to create a for-profit consortium focused on undergraduate education. The consortium will bring together schools including Brown, Amherst, Williams, Princeton, Stanford, Dartmouth, and Cornell.²⁰¹
- The Secretary of the Army proposed to pay for a two-year associate’s degree from an accredited, on-line institution to encourage further education among soldiers.²⁰²

Education-related companies such as Concord University School of Law are also developing for-profit institutions. This law school is part of Sylvan Learning’s chain of private for-profit universities. These for-profit ventures also include certificate programs developed by corporations such as Microsoft and Novell.

Clearly this trend will have implications for educational content at institutions of higher education in the coming decades. This shift to for-profit and on-line educational facilities will influence the types and kinds of buildings that are used to deliver educational services both on and off campus.

On-campus education may drift from the lecture model where content is delivered in a lecture hall or classroom to a model where the formal content is delivered on-line through media such as video, simulations, and exercises. Contact with faculty is likely to shift to less formal interactive sessions where faculty and students may meet physically or electronically. It is increasingly possible to have students and professors, but especially students, complete laboratory work in virtual laboratories. This raises questions about what laboratories of the future might be like, how many will be needed, and where they may be placed. In turn, all of this raises interesting questions about the future of residential education, as we know it. It is much too early to suggest dramatic changes in residential colleges but there is little doubt that the way in which residential colleges are organized will change over the next 20 years.

Off-campus education is already being delivered in nontraditional venues such as office buildings and the home. This may be especially beneficial for students who are unable to afford an education at a residential institution.

We noted above that employers are offering on-site courses to their employees. These courses can be tailored to the specific needs of the company raising interesting questions

²⁰⁰ “Online.” Chronicle of Higher Education 3 March 2000: A41.

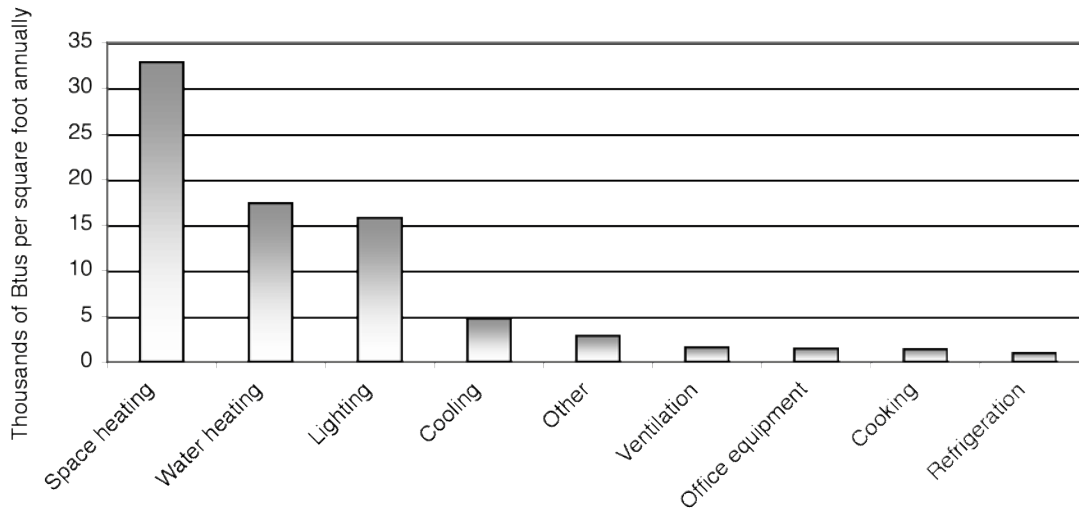
²⁰¹ Carr, Sarah. “Distance-Education Company Woos Bastions of the Liberal Arts.”

²⁰² Suro, Roberto. “Army Considers Education as a Recruitment Tool.” The Washington Post December 10, 1000: A1.

about the value of general education. The availability of on-line education may increase interest in education. People may begin to take courses of interest rather than working toward a degree.

Energy end-use in the education sub-market

Figure 120 displays the most recent CBECS energy end-use intensity data for the education market. The data are only available for the sub-market as a whole and are now about five years old. Space heating has the highest energy use intensity. If heating, cooling, and ventilation are combined, they represent just about half of the 79 KBTus per square foot annually. Water heating and lighting account for 22 and 20 percent respectively.



Source, DOE EIA "A Look at Commercial Buildings in 1995: Characteristics, Energy Consumption, and Energy Expenditures, Oct. 1998, Tables EU-2, p. 311

Figure 120 End-use energy intensities in the education segment

In 1998 it was estimated that K-12 institutions spent \$6 billion nationwide on direct energy costs. That works out to approximately \$100 per student per year although that value varies with the local climate and utility rates.

A recent article in the Christian Science monitor suggested that campuses are among the worst of the commercial buildings in terms of energy use.²⁰³

Among other things the article notes that:

- The annual energy bill for all colleges and universities combined is estimated to be about \$6.5 billion.
- There was a rapid expansion of campus buildings in the late 1990s that added as much as a half billion square feet to the existing 3.5 billion square of space.
- While many of the newly constructed buildings were constructed using energy efficient practices and technologies, they were also built with air handling systems and electronics that raise consumption.

²⁰³ Clayton, Mark, "The Drive for Power," *Christian Science Monitor*, July 3, 2001.

- The older less efficient buildings that the new buildings “replaced” are still being used.
- Students have significantly more appliances in their rooms than 10 or 15 years ago.

The aforementioned article presented a table showing campuses with the best and worst energy end-use intensities (Table 56). There are several points to be made based on this article. The first is that the spread in energy-use intensities among colleges is very large. The heaviest users use almost four times as much energy as the lightest users. A second point is that heaviest users are using five times as much energy as was calculated for all schools in 1995 (See Figure 27) and twice the average energy use intensity of inpatient health care facilities. A third point is the very large range of expenditures per student among these colleges. Expenditures range from a low of \$56 per student to a high of more than \$4,700.

Table 56 Examples of energy use intensities at post-secondary institutions

Institution	State	EUI kBtu/square feet	Dollars per student
Heaviest users			
Citadel Military College	SC	485	\$685
University of Missouri, Columbia	MO	461	\$826
Purdue University	IN	429	\$259
Duke University	NC	424	\$1,616
The University of Tulsa	OK	417	\$488
University of Arkansas	AR	411	\$326
New Mexico State University	NM	404	\$841
University of Missouri	MO	402	\$945
Louisiana State University, School of Medicine	LA	389	\$1,533
University of IL-Champaign-Urbana	IL	387	\$585
Lightest users			
Moravian College	PA	136	\$560
University of the South	TN	134	\$1,037
Azusa Pacific University	CA	133	\$161
Haverford College	PA	129	\$997
Mount Holyoke College	MA	127	\$713
Central Piedmont Community College	NC	123	\$171
University of Wisconsin-White Water	WI	120	\$128
University of Miami	FL	110	\$186
Portland State University	OR	91	\$130
Marquette University	WI	88	\$196

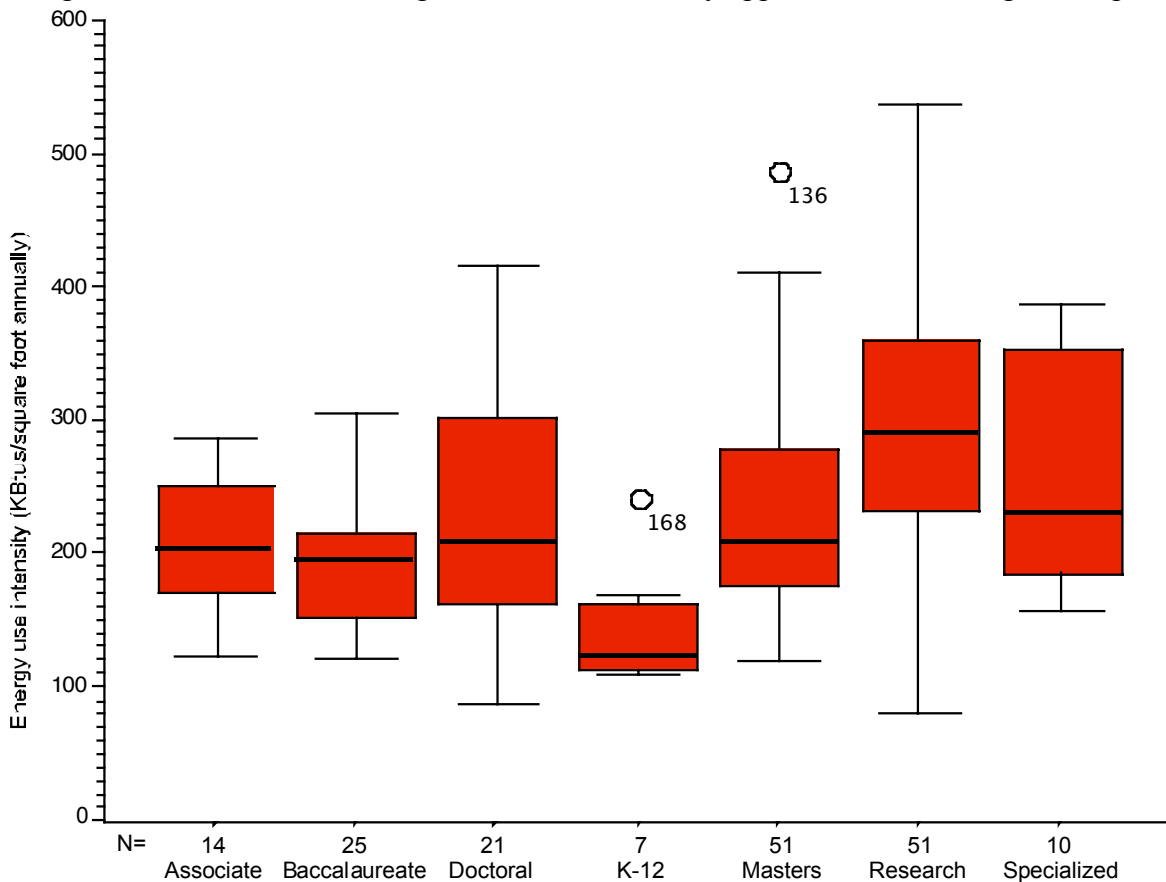
Source: Association of Higher Education Facilities Officers Survey of 200 Colleges; Department of Energy's Rebuild America analysis as cited in Clayton, Mark, "The drive for power," *Christian Science Monitor*, Tuesday, July 30, 2001.

We were curious as to what might account for the huge variations. Our initial thought was that climate would be an important factor. However, as we examined the data we discovered that institutions with some of the lowest energy use intensities were in the

North and some with the highest energy use intensities were in the middle states or the southeast. Cooling loads might be an explanation but the predominate energy use is heating.

We were able to locate the data on which this study was based.²⁰⁴ The data included a number of variables such as energy use intensity per square foot, energy cost per million Btus, cost per student, the public or private status of the university, and the Carnegie classification. The Carnegie classification identifies schools by the type of education they provide and the extent to which they are a research institution. Because the physical locations of the institutions were identified, we were able to add variables for heating and cooling degree-days to the data.

Figure 121 is a box and whisker plot showing the means, 25th and 75th percentiles, and range of the data. Several things become immediately apparent from looking at this plot.



Source: Higher Education Energy Performance Based on APPA's 1997-98 CCAS Study, APPA Rebuild America Strategic Partnership, August 2000. <http://eber.ed.ornl.gov/commercialproducts/CCAS9798.htm>.

Figure 121 Means and ranges for 179 educational institutions by Carnegie classification

The few K-12 schools in the same have the smallest mean and the tightest distribution around the mean. Schools classified as associate, baccalaureate, masters or doctoral in-

²⁰⁴ Higher Education Energy Performance Based on APPA's 1997-98 CCAS Study, APPA Rebuild America Strategic Partnership, August 2000. <http://eber.ed.ornl.gov/commercialproducts/CCAS9798.htm>.

stitutions have similar means around 200 KBtus/square foot annually. Research institutions have the highest mean followed by specialized institutions. What is notable about the institutions offering higher degrees is that the interior variation, i.e., the variation between the 25th and the 75th percentiles, is very similar but there is substantial variation in the outer parts of the distribution and the range. The large variation for research institutions makes it very noticeable. This plot suggests that the type of institution may be a key factor in explaining energy end use.

To gain a better understanding of the factors that might contribute to the variation in energy use intensity, we regressed heating and cooling degree-days, enrollment, area, Carnegie classification, and whether the institution is public or private on energy use intensity. In order to do this, we created six dichotomized variables for Carnegie type, one for each type of institution except K-12, which was by default a “0.” Because the distributions of the various variables were so different, we normalized the variables so that they had a mean of zero and a standard deviation of one.

In our initial analysis, the cost of energy was not included. In that analysis, we found that heating and cooling degree days, area, and offering a masters degree, being a research or specialized institution, or a public institution were all significant. This analysis explained about 30 percent of the variation in energy intensity. We then re-ran the analysis but included the cost of energy. In this analysis, heating degree-days dropped out but cooling degree-days remained in the equation, being a masters institution dropped out, while being a research, specialized, or public institution remained. Energy cost was also significant and negative in sign, meaning that energy use decreased with the cost of energy. This equation explained about 36 percent of the variation.

Finally, we completed a stepwise regression analysis to see which variables explained the most variance. In a stepwise analysis, the variable that explains the most variation is entered first, the variation due to that variable removed, the next most important variable entered, the variation due to that variable removed, and so forth. There were four variables in this analysis. The variables in order of occurrence were being a research institution, cost of energy, being a public institution, and being a specialized institution. This equation explained 26 percent of the variance.

There are several important points that seem to emerge from this analysis.

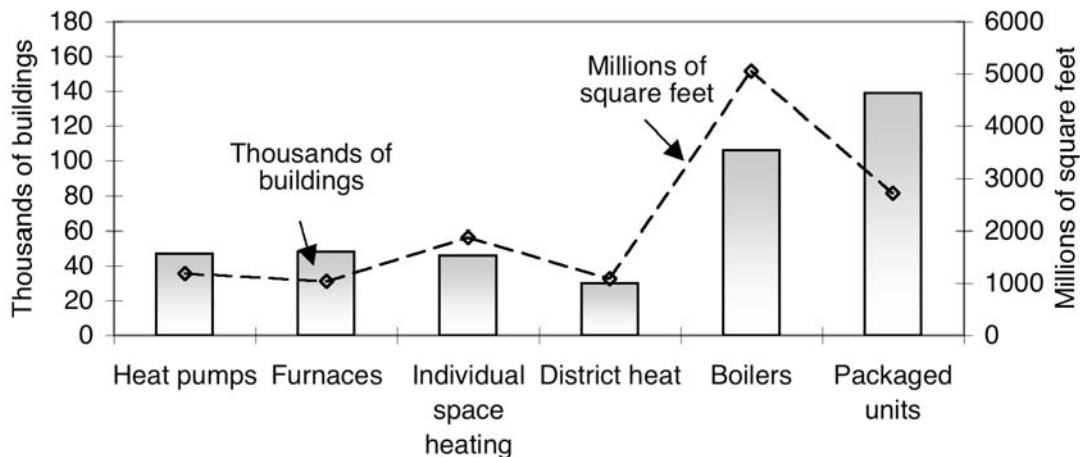
- The variables in our analysis only explain 26 to 36 percent of the variation. Thus, there are clearly other factors that play into energy use, for example, commitment to keeping energy costs low, the state of repair of buildings, the age of buildings, and how recently buildings have been renovated.
- Research institutions tend to be more energy intensive than others. This may be because of the energy use of equipment found in laboratories and energy use from equipment such as ventilation hoods. Classroom, office, and laboratory spaces are likely to be used more hours of the day than at non-research institutions. Laboratory buildings may be generally less efficient than other buildings.
- Cost of energy clearly is a factor in energy use intensity. Institutions in areas with high energy costs clearly use less.

- Private institutions have lower end-use intensities than public ones. This may have to do with the where, when, and how instruction is delivered. Energy costs may be a factor here as well. Regardless of the geographic distribution of energy costs, private institutions may be more concerned than public institutions about keeping energy costs down in order to remain competitive in the educational market.
- Finally, specialized institutions may have activities and equipment that result in greater energy intensity.

These data suggest that colleges and universities are important targets for energy efficiency. There is clearly more to be learned about the factors that contribute to energy use among educational institutions. The Department of Energy is quite aware of this and is focusing on energy use at post-secondary institutions as part of their Rebuild America program.

Energy technologies in the sub-market

Using the CBECS data it is possible to examine the energy technologies being used in the education sub-market. As can be seen from Figure 122, boilers and package units are the dominant heating technologies in the submarket as a whole. Boilers are found in buildings accounting for about 58 percent of the total square footage. Package units are found in 42 percent of the buildings.

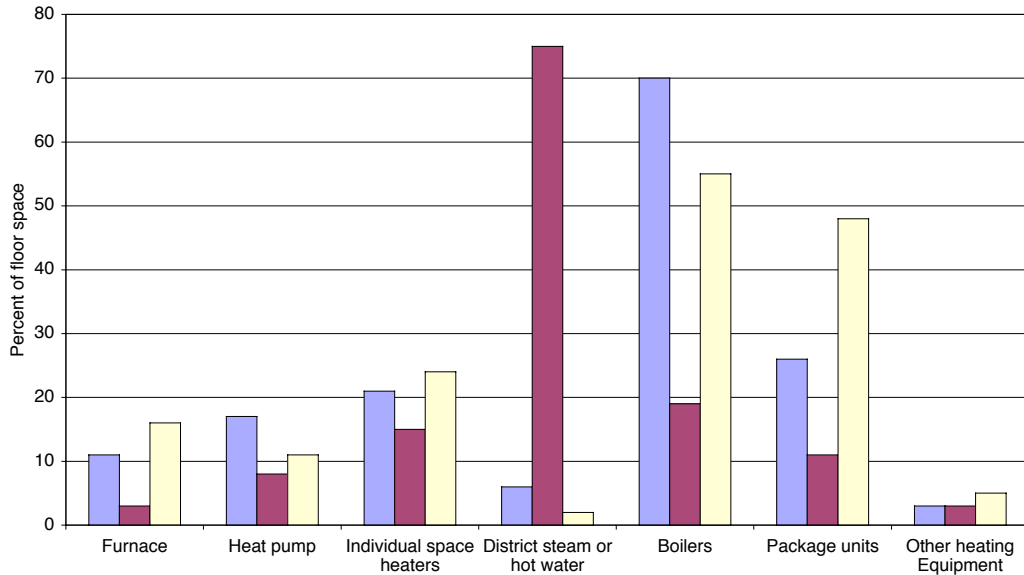


Source: EIA, CBECS Tables B32-B33, 1999

Figure 122 Types of heating equipment installed in the educational sub-market

In the published tables, CBECS does not provide a breakdown of by college and university and K-12. We examined the CBECS public use sample to see if it was possible to provide a better breakdown. A number of the buildings in the CBECS public use sample are not classified by level or type of education. We were able to create three classifications, college and universities, K-12, and education unspecified. Using these classifications, it was possible to create percentages of total floor space for buildings with different types of heating equipment. Figure 123 shows that a very high percentage of college and

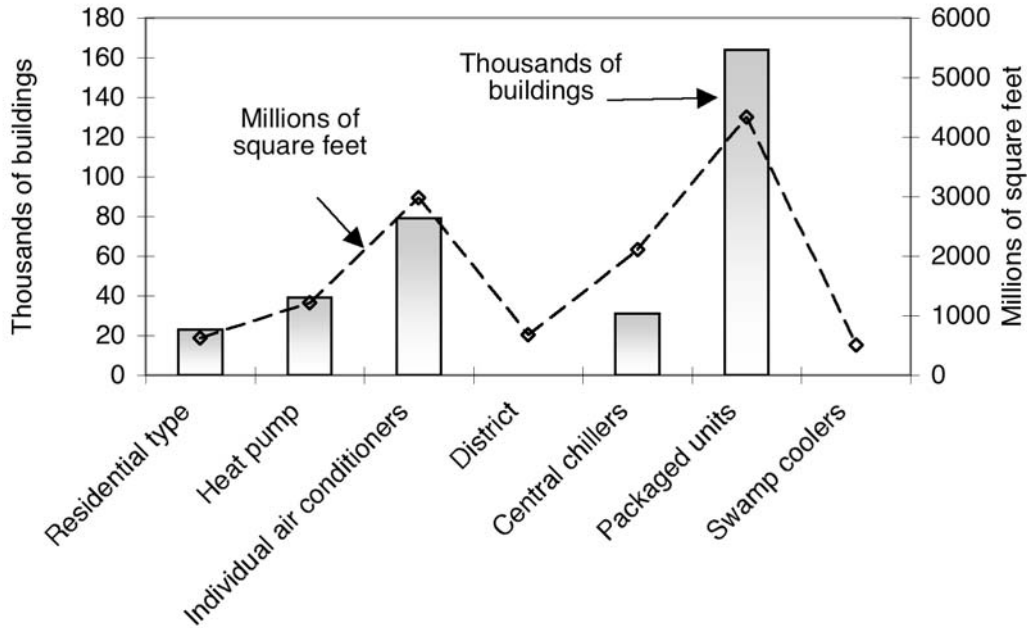
university campus floor space is heated using district heat. The K-12 schools and those buildings not classified had high percentages of boilers and package units. For the K-12 schools it appears that boilers and package units are found in about 50 percent of the buildings. Buildings can have more than one type of heating technology. Although we cannot prove it, we suspect that older buildings have boilers and new buildings have package units.



Source: DOE, EIA, CBECS public use sample as analyzed by Innovologie, LLC.

Figure 123 Buildings accounting for percentage of floor space with type of heating equipment

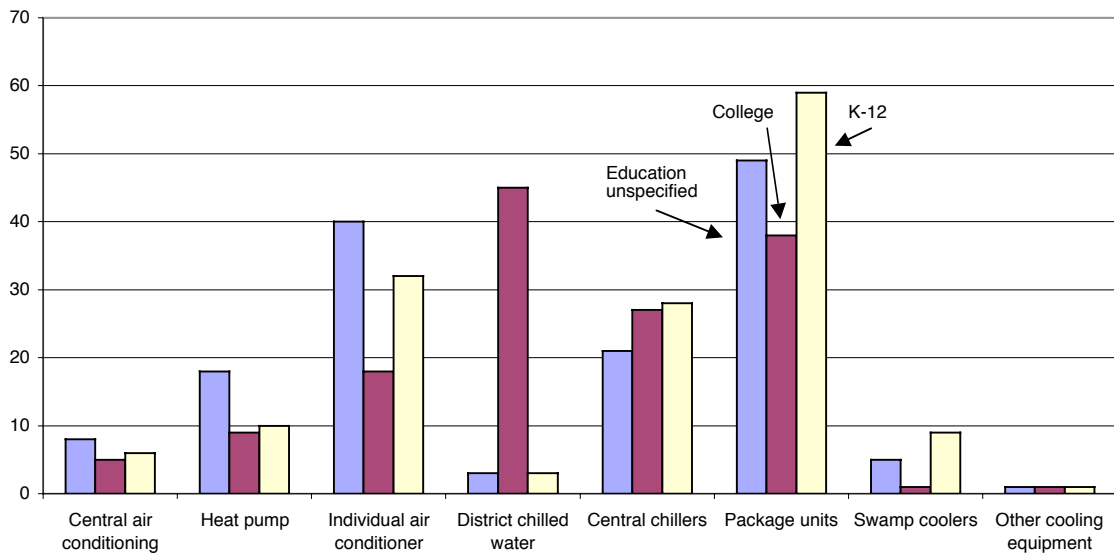
In a similar fashion we were able to examine air conditioning (Figure 124). Traditionally, many education buildings have not had air conditioning because school was not in session during the summer months. This may be changing with the length of the school year increasing and some school districts having year round classes. Package units are found in the most buildings (50 percent) and buildings with the most square feet (50 percent). What is noticeable is that there is a high percentage of buildings (25 percent) with individual air-conditioning units although the buildings in which these are found only account for about 14 percent of the square footage.



Source: EIA, CBECS Tables B34-B35, 1999

Figure 124 Types of cooling equipment installed in the educational sub-market

As with the heating equipment, it was possible to compare the relative percentages of space in the K-12 and college and university markets served by different types of cooling equipment. For colleges, district chillers served buildings with more than 40 percent of the floor space. Package units provided cooling for between 40 and 60 percent of buildings in all three categories. Individual air conditioning units appear more frequently in K-12 buildings and in the education unspecified category.



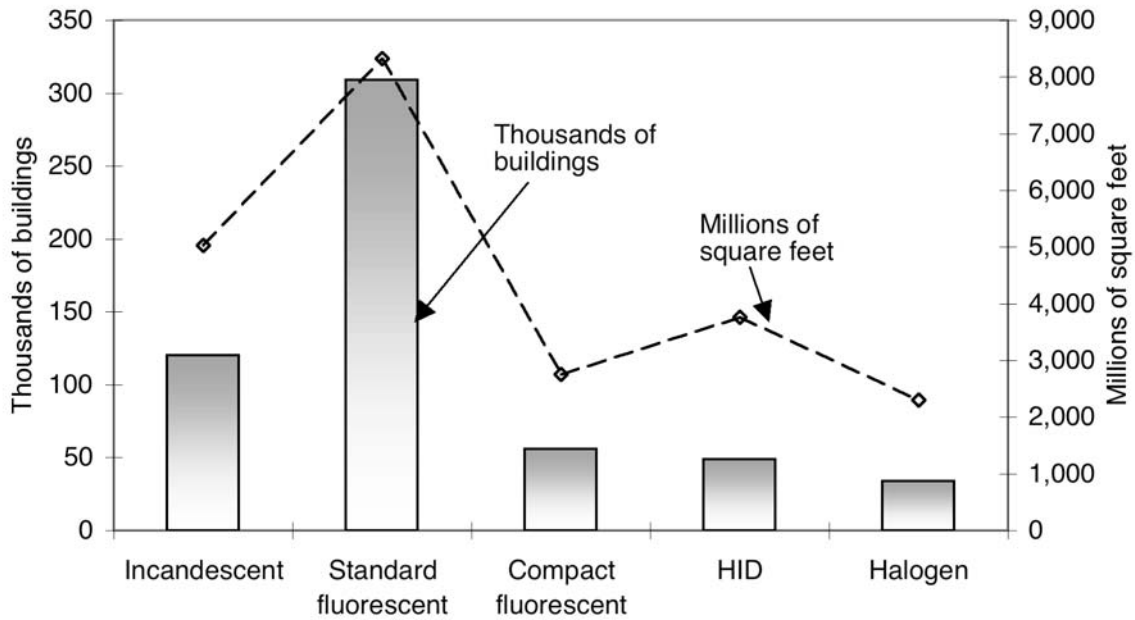
Source: DOE, EIA, CBECS public use sample as analyzed by Innovologie, LLC.

Figure 125 Buildings with percentage of floor space by type of cooling equipment

Figure 126 shows the overall breakdown of lighting equipment in the overall education market. Standard linear fluorescents are found in 94 percent of buildings. Incandescents are found in 37 percent of buildings. Buildings accounting for 97 percent and 58 percent of the total floor space have fluorescent and incandescent lighting respectively. The graphic also shows that HID lighting is found in 15 percent of buildings with 48 percent of the space. This implies that HID lighting is associated with larger and probably newer buildings. This type of lighting would be found in large spaces such as athletic facilities.

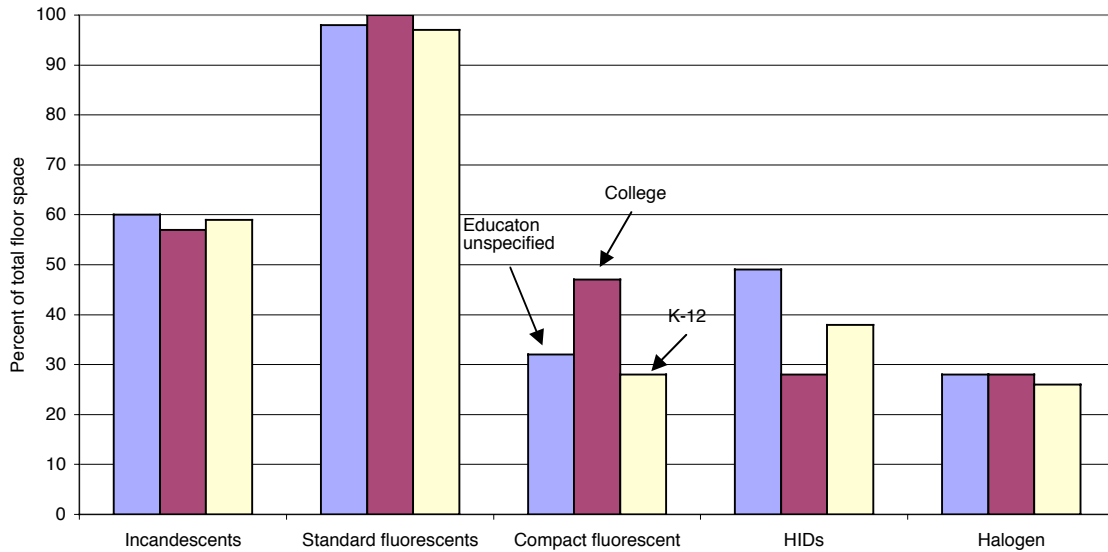
We looked at lighting by type of education facility. As a percentage of floor space, colleges and universities are slightly more likely to have compact fluorescents while K-12 buildings are slightly more likely to have HID lamps. Otherwise, there appear to be few differences across the types of facilities.

Finally, we used the CBECS data to see if there are any differences among education types with respect to practices and technologies that might be more energy efficient. More than 70 percent of the floor space at colleges and universities are reported to have electronic ballasts. This suggests that efficient lighting has penetrated these facilities.



Source: EIA, CBECS Tables B38-B39, 1999

Figure 126 Types of lighting equipment installed in the educational sub-market



Source: DOE, EIA, CBECS public use sample as analyzed by Innovologie, LLC.

Figure 127 Buildings with percentage of floor space by type of lighting equipment

It is not appropriate to compare the presence of variable air volume technologies and economizers among educational facility types. However, it is helpful to get some idea of the penetration of these technologies within facility types. More than 40 percent of the college floor space has variable air volume technology. More than 60 percent is reported to have economizers.

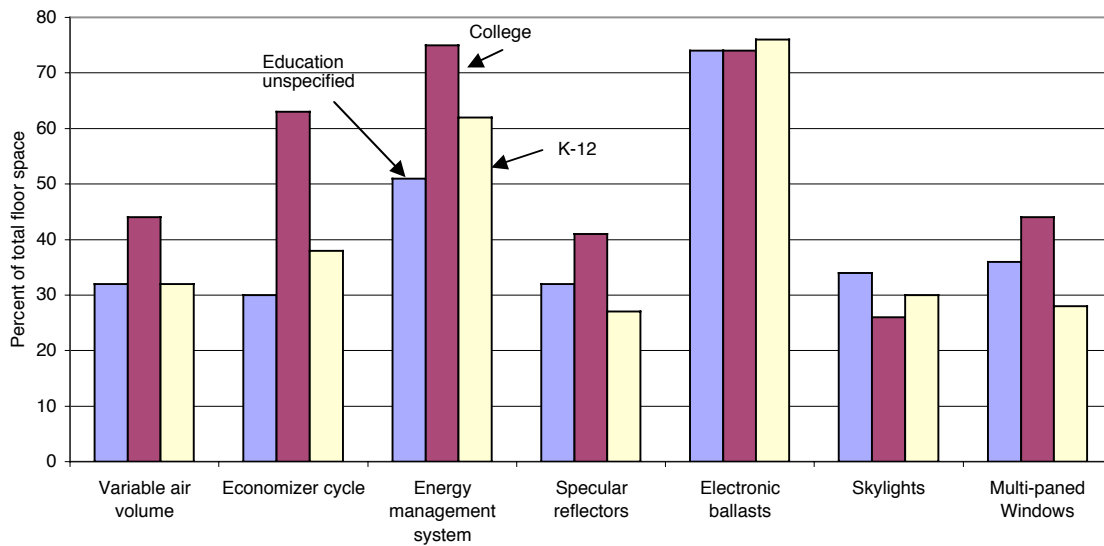
Buildings representing about 70 percent of the college and university floor space report having energy management systems. This is higher than for K-12 facilities. Finally, colleges and universities reported a greater percentage of floor space with multi-paned windows than did K-12 institutions.

Summary, conclusions, and recommendations

The education sub-market consists of 327,000 buildings that have more than 8.65 billion square feet. Fifty-eight percent were built before 1970 and the median age is more than 35.5 years.

The market can be divided into the K-12 market and the post-secondary market. There are approximately 120,000 buildings in the K-12 market. This market can be further subdivided by public and private. The public market represents about 77 percent of the total and the private market about 23 percent.

There are some very large players in the public market. The top 100 school districts have more than 44,000 pupils each and an average of 159 buildings per district. Roughly 16.5 percent of the student population attends these schools. Because of the number of buildings and the number of buildings under construction, these districts, and even districts half the size of these, are important targets for energy efficiency efforts.



Source: Doe, EIA, CBECS public use sample as analyzed by Innovologie, LLC.

Figure 128 Buildings with percentage of floor space by the presence of efficient technology

The private education sector has three main segments: Catholic schools, other religious schools, and nonsectarian schools. Organizationally, there may be ways to approach Catholic schools at a broad level to promote energy efficiency. Many of the other religious schools and nonsectarian schools are independent schools and may have to be approached on a one-to-one basis.

There are several factors that may lead to increased energy consumption in public K-12 schools over the next several years: longer school hours, clustering of buildings and sharing resources among schools, year-round classes, and individualized instruction.

The use of computers in classrooms is evolving very rapidly. In 2000, 98 percent of schools had Internet connections, 77 percent of classrooms had an Internet connection, and the ratio of pupils to computers declined from 12 students per computer in 1998 to seven students per computer.

Some have suggested that the use of computers in the classroom will lead to larger classrooms and increased energy use. The rapid shift from desktop to laptop computers and the introduction of wireless technologies will increase the use of computers but may reduce the pressure for larger classrooms that would have resulted with the continued installation of desktop units. Also the energy use of the laptop units may not be as substantial as the desktop units.

The introduction of computer means that there are likely to be shifts in the way students are taught and shifts in the way classrooms are organized. These shifts are likely to have profound implications for the physical design of school buildings. These changes will have some energy impacts but the impacts may not be as large as was assumed as little as three years ago.

There are some other trends in K-12 education. One trend is for new high schools to be larger. There is increasing pressure from the public and green building advocates to build

green buildings. Green buildings are typically more energy efficient than older buildings but green buildings may be optimally efficient rather than of maximum efficiency. Building green may result in trade-offs between energy efficient technologies and green materials and technologies.

Another trend is an increased interest in daylighting. Daylighting has been linked to improved test scores. Good daylighting design is important because there is potential for daylighting and the use of LCD computer technologies to conflict if building design is not well done.

We also note the emergence of virtual schools. To what extent this may reduce the need for classrooms or increase home energy use is not clear.

According to the National Center for Educational Statistics, there are approximately 9,600 institutions of higher education in this country. Twenty-three percent of these institutions are public institutions, 29 percent are nonprofit, and 48 percent are for-profit institutions. The facilities for these institutions range from offices to sprawling campuses with large amounts of student housing, large classroom and office buildings, laboratories, and large athletic and entertainment complexes.

Post-secondary educational institutions are changing dramatically. For-profit and virtual institutions are emerging. Examples of these new types of post-secondary institutions include the University of Phoenix, consortia of related universities, and spin-offs of nonprofit institutions. The changes in educational offerings at the post-secondary level will affect the ways in which students learn and courses are delivered.

The shift to for-profit and on-line educational facilities will influence the types and kinds of buildings that are used to deliver educational services both on and off campus. On-campus education may drift from the lecture model to a model where content is delivered on-line. Face-to-face contact with faculty may be displaced to some extent by electronic contact. Laboratory work may be done in computer-based virtual laboratories. This raises interesting questions about the future of residential education and the continued growth of campuses.

Off-campus education is already being delivered in nontraditional venues such as office buildings and the home. Employers are offering on-site courses to their employees. These trends will continue and accelerate. This too will influence the nature of residential education.

In terms of energy use, evidence suggests the most intense energy uses in the education market are for space heating. There are some striking differences in heating technologies by type of institution. Older K-12 schools appear to use boilers while newer buildings utilize package units. Many post-secondary institutions have district systems.

If the drive for longer school years and year round schooling continue, air conditioning will become a necessity in K-12 schools. There is some evidence that most new K-12 school construction is incorporating air conditioning. However, many older buildings will have to be retrofit. The data suggest that older buildings that have been retrofit have used window units. Window units are likely to be inefficient and to prove unsatisfactory. Whether school districts will continue to do this as a way to deal with the need for air conditioning in older buildings is unclear.

The evidence we have assembled suggests that post-secondary institutions, perhaps most typically the research and specialized institutions have some of the highest end-use intensities in the commercial sector. Our analysis of the CBECS data suggests that technologies with the potential to save energy have penetrated campuses. It appears that many of the gains from energy conservation technologies may have been offset by construction of larger more complex campus buildings, continued use of older structures that may not have had energy retrofits, and an increase in the number and types of appliances used by faculty and students. This points to a need to continue to develop comprehensive approaches to energy efficiency, such as those being encouraged by Rebuild America, including identifying energy usage savings in classrooms, science labs, and dormitories.

These findings suggest that there are numerous opportunities in the educational sub-market to promote energy efficiency and conservation at all levels. Large school districts and large post-secondary institutions are important targets for energy services because of the existing buildings and because of the number of new buildings they build.

The widespread penetration of computer and Internet technology means that students may more often be learning in nontraditional places, such as dorm rooms, offices, and at home. This trend will shift resources away from the “bricks” of educational facilities and focus more on ways to enhance and adapt telecommunications and computer technologies to meet the needs of the rising student population in the United States.

Chapter 12 Summary and Recommendations

Introduction

Much of what the Department of Energy does in the energy efficiency arena is technology driven. Promising technologies are identified, developed, and transitioned to the private sector. Some technologies take off while others languish. A number of people have suggested that there should be greater linkage between the research that is done and the markets to which the products are to be deployed. This is especially critical given the limited resources that are available to address energy efficiency across the commercial market.

In order to increase the linkage between the research and the markets, it is important to understand the markets, the players in the market, and how the players in the market make decisions. This report examines the players and the decision making in the commercial building market. It provides both an overview of the commercial building market and a closer examination of seven of its sub-markets: office, retail, food sales and service, lodging, healthcare, warehousing, and education.

This summary brings together many key findings. In addition, we offer a number of recommendations. The recommendations are intended to identify areas where new or continuing efforts are needed. In some areas, DOE is well on its way to implementing the recommendations.

A heterogeneous market with many sub-markets

The commercial building market is a heterogeneous market comprised of a number of sub-markets that can be further segmented. This study makes a substantial contribution in understanding these markets and segments but much additional work is needed.

In this research, we have identified many of the large players in the various submarkets. In some instances, it has been possible to sketch decision-making patterns and decision criteria at some level of detail. There is still much that is not known about the markets, the sub-markets, and the decision-making processes. In particular, it is important to know in which sub-markets and segments and to what extent players may already be addressing efficiency issues, and in which sub-markets and segments efficiency may be lagging. We believe that knowing more will allow the DOE to make wiser choices about which technologies to pursue, to increase its partnerships in this market, and to make it possible for the technologies it develops to gain more rapid acceptance and move more rapidly into the market place.

Almost all of the data in this report were derived from the Internet. Much of the data comes from trade associations and trade publications. A key finding is the availability of significant data and information from secondary sources that the DOE can use to monitor and understand the commercial building market.

We recommend that DOE commit resources to continuously and systematically updating its understanding of the commercial building

market, to making greater use of secondary information in expanding its understanding of the commercial building market, and to accessing secondary information through partnerships and relationships with firms and associations that are already collecting such information.

A key theme

As we examined the various sub-markets we found that most were made up of two groups, large national players and smaller regional and local independents.

- In nearly every sub-market, we found a relatively high degree of concentration of ownership or franchising of establishments.
- These owners are large national and regional firms.
- It is clear that there is significant potential to promote a substantial amount of energy efficiency by targeting relatively few large players in each sub-market.
- We do not know to what extent these large players may be attending to energy efficiency issues. Within sub-markets some players seem quite sophisticated in this regard while others do not.
- Effectively targeting these large national and regional firms will require national strategies that involve partnering with the major players, the trade associations to which the major players belong, other Federal agencies, national and regional market transformation organizations, and others.
- At the same time, there are large numbers of smaller independent players at the regional and local level that need the benefits of energy efficiency as well. Within the sub-markets, these players are more similar than they are different.
- Strategies to target these smaller independent players need to be implemented by public benefits agencies, energy efficiency organizations, and utilities at the local level. The understanding of these local commercial establishments and the sophistication of the strategies being used to deal with them vary but is typically not high.
- The Department of Energy and other Federal agencies can play a role with regional and local implementation agencies by helping to develop sophisticated implementation strategies that can then be modified and used by regional and local players.

We recommend that the DOE partner with other interested parties at the national level to address technology and implementation issues that focus on the needs of large national and regional players in each of the sub-markets.

We recommend that the DOE consider sub-market specific events such as workshops that involve the largest players and their trade associations to increase DOE's understanding of relevant issues in the submarkets, long-term directions in the sub-markets, technology needs, decision-making structures, and key decision criteria.

We also recommend that the DOE work with national, regional, and local players to develop technologies, strategies, and resources that meet the needs of smaller regional and local players in each of the sub-markets and support the efforts of regional and local players in diffusing the technologies and implementing the strategies that are developed.

Buildings in the future

There are many forces for change in our society that will influence what buildings are built, where they are built, how the buildings are used once they are built, and how frequently they have to be renovated or modernized. The drivers of change are technological and organizational changes in communications, energy, transportation, nanotechnology and biotechnology, manufacturing, and materials. These drivers will affect all sub-markets within the commercial building market.

Changes in communications will, for example:

- Affect the ways in which office workers conduct business and the amount of traveling they do.
- Influence the ways in which restaurants organize their kitchens and prepare meals.
- Accelerate the shopping cycle, making goods more readily available to customers and increasing demands on warehouses and eliminating middle firms
- Improve the quality of healthcare by providing preventive, proactive healthcare through networks of linked informational sources about patients and their conditions.
- Offer increased options and benefits to busy travelers trying to keep in touch on a global scale.
- Provide new and expanded opportunities for students to advance their education through on-line courses.

Changes in the production, distribution, and control of energy will:

- Reduce energy consumption at the office while promoting more flexible and personalized workspaces.
- Provide restaurants with information needed to better manage their kitchens, refrigerators, and overall operations.
- Allow retailers to display goods more profitably and create more comfortable shopping experiences.
- Provide hotels, warehouses, hospitals, and educational facilities with the ability to better manage their energy usage through greater information tools and technologies.

Changes in transportation will:

- Significantly shorten the commuting times for office workers
- Increase the options and flexibility for retailers, relying even more heavily on the warehouse sub-market for final goods processing and delivery.

- Expand offerings in both restaurants and grocery stores to more “take-away” items that ease the time pressure busy customers face on a daily basis.
- Improve patient healthcare by transferring difficult cases more immediately to larger regional medical centers.

The advent of nanotechnology and biotechnology will:

- Improve healthcare by providing more specialized tools and treatments to handle difficult procedures and make it possible for much of healthcare treatment to be delivered in office and home settings.
- Improve the overall efficiency of communications, effectively eliminating the need for large complex offices and creating the ability to promote telecommuting and wireless workforces.

Changes in manufacturing will:

- Streamline the process and shift more of the actual product work to warehouses in an effort to speed up supply lines.
- Create more flexible product lines that are more adaptable to changing consumer whims and making retailers even more price competitive.
- Make it possible to mass customize buildings.
- Improve healthcare technologies available to patients through more complex medical equipment that is small in size.

Advances in materials will:

- Allow for the development of more resilient products to improve overall operating efficiencies in the office, education, healthcare, and warehouse sub-markets.
- Create materials that will allow buildings to be stronger but lighter and have different dynamic properties that can change the ambiance.

The important points with respect to the future are that:

- Buildings will be structurally different.
- Buildings will be built using different processes.
- Building environments will be very different.
- Current uses of buildings will change dramatically.

We recommend that the DOE commit resources to continuously and systematically identifying and tracking trends that will influence buildings in the future and incorporate that information into its planning efforts. This might include closely track emerging efforts to build commercial building using component methods and high tech materials.

The DOE should consider partnering with companies doing core out design software to incorporate efficiency calculations into such software.

Decision-making

This study identifies five categories of decision makers: capital providers, developers, users, building professionals, and community regulatory interests.

Capital providers set the limits on a project by placing a value on the features and amenities in a building. They commit to financing a building with those features. Once the financing is in place, the financing is unlikely to change. Changes to a construction project -- and there are usually many -- have to be accommodated within the financing package. Financing is established early, usually well before design drawings and detailed specifications are developed. In order to ensure that energy efficiency is a part of a project, it must be considered in the cost estimates that are used to obtain the financing.

Developers are another important set of decision makers who bring together investors, designers, contractors, and users. Developers, as represented by the investment managers, are interested mostly in return on investment. Large developers/owners have staff to whom they delegate details like calculating return on investments for such things as energy efficiency projects. Managers pick and choose among the alternatives.

Developers have general investment strategies. These strategies set the parameters within which investments are made. The investment strategies encompass a much broader set of issues than energy efficiency. There are many opportunities to invest money in buildings. Among other things, one can upgrade a lobby, increase the speed of the elevators, buy improved maintenance equipment, upgrade space for a tenant, invest in energy efficiency, or buy another building. Each item represents an opportunity and has potential for return on investment.

Users are a third important category of decision maker. We speak of users rather than owners because users may be either lessees or owners. The user who is paying the bill is likely to obtain the desired amenities. An important point in this report is that lessees can have significant influence over design decisions. This is particularly true of larger national retailers and large companies that lease significant amounts of office space. Decisions regarding how space can be used and modified in leased buildings are part of the negotiation between the lessee and the owner or the owner's representative. The degree to which a tenant can control the design and features of a space is largely a function of what the tenant is willing to invest in the space or to pay.

Building professionals — e.g., architects, designers, and engineers — may have more or less influence over decisions depending on the organizational model that is used to manage construction. In the design/plan/build model, which is the traditional architect centric model, the architect plays a key role. In the design/build model, the contractor-developer is the key player. Other professionals tend to have supporting roles. In the design/build model the engineer may be left with the problem of choosing among technologies to keep a project within budget. In the emerging collaborative model, the team as a whole plays a much more central role in decision-making. One of the key issues with respect to the role

of building professionals is the degree to which they are able to integrate their efforts across disciplines. Integration tends to be a low priority in the design/plan/build and design/build model and that likely leads to poorly designed buildings.

Decisions about commercial buildings are highly complex and involve gathering information for and from a variety of different market actors. Many times, a few market actors may be responsible for making decisions about many buildings. Moreover, these same decision makers may have interlocking roles in both new and existing buildings. Finding these commonalities has been quite difficult in the past. Network analysis, which traces the inter-relationships among various market players, makes it easier to find these common links.

We recommend that the DOE commit resources to increasing its understanding of who the decision makers in the commercial building community are, to identifying the parameters that determine who the decision makers are across a broad range of situations, and to identifying the value criteria that are used in decision-making.

Commercial building market overview

Our general examination of the commercial building market identified several key findings.

- A high percentage of commercial buildings are owner occupied. Split incentives are not a barrier to the adoption of energy efficiency for this group. Evidence from various places in this report suggests that split incentives may be a barrier for a very small percentage (5 to 15 percent) of the commercial building market.
- Half of commercial buildings are less than 5,000 square feet. Efficiency efforts need to be geared to these properties as well as larger properties.
- The efficiency programs that have been operated by utilities and regional transformation organizations have been oriented to lighting and cooling. Heating is a large load that needs attention as well.
- Construction in the commercial building sector was strong in the 1980s and 1990s. Building construction in the office, retail, and industrial markets was declining as a percentage of GDP in the late 1990s suggesting some uncertainty about the future.
- In the overall commercial building market, the rate of remodeling and renovation tends to be fairly constant while the rate of new construction is more volatile trending with economic ups and downs. The renovation market is as important as the new construction market. Building professionals tend not to see these as separate markets although developers do.
- Historically, small and large buildings rather than mid-sized buildings have been most commonly constructed.
- Overall energy use and overall energy intensities have risen over the years. Energy intensity appears to have declined in the healthcare, office, and lodging sub-markets during the 1990s. However, the decline in the energy intensity in the healthcare sub-

market may result from a structural shift in how services in the sub-market are delivered.

The office sub-market

Since the 1970s, there has been a trend for companies to lease rather than to own buildings. This trend was particularly noticeable in the 1990s. This may reflect a business strategy of focusing on core business activities and avoiding distractions such as real estate operations. It also enables firms to be flexible in their space demands.

Owner-occupied buildings are smaller. They are more likely to be low rise with the exception of single story buildings that are relatively more likely to be leased. In comparison to non-owner occupied buildings, owner occupied buildings are more likely to be single occupant buildings and, when multiple occupants are present, they have fewer tenants than non-owner occupied buildings.

In the 1990s, about 108 million square feet of new office space was built annually. The top 25 office developers may have developed as much as 70 percent of this space. The top 25 commercial property owners own approximately half a billion square feet which is approximately a sixth of commercial office lease space. Thus, a large percentage of new construction is done by a relatively small number of firms and ownership of lease space is highly concentrated as well.

Much attention has been given to the idea that tenants lease office space and that tenants pay their own energy costs. As a result, it is assumed that it is difficult to encourage energy efficiency in commercial office buildings because owners do not receive a return on energy efficiency investments, that is, the benefits are split (split incentives). As noted above, a high percentage (62 percent) of commercial buildings are owner-occupied. Thus, split incentives should not be a barrier in these buildings.

Who pays the energy costs in leased office space is dependent on the lease and the physical characteristics of the building and the lighting, heating, and cooling systems. Leases are written in different ways even for tenants within the same buildings. Many leases are written in such a way that owners are responsible for a base portion of utilities with the tenant responsible for costs above a threshold. The introduction of energy efficiency measures may reduce costs associated with the owner's base, increase the asset value of the building, and make the lease terms for the building more attractive to potential tenants. Thus, in many lease situations the benefits accrue to the owner who is paying the energy bills.

Leases are written so that tenants largely specify the characteristics of the space. In situations where the tenant is responsible for the energy costs, tenants may either install their own equipment or specify how the space is to be equipped. Thus, even in this situation, the firm paying for energy is the beneficiary of the savings.

Given these circumstances, split incentives may be a barrier to energy efficiency in a very small proportion of all office situations.

It appears that efficiency measures are penetrating this sector. Substantial percentages of floor space appear to have efficient technologies installed in them.

We recommend that the DOE assess the extent to which the top 25 to 50 office developers are incorporating energy efficiency into new office buildings and what changes to existing building practices and technologies might result in more efficient office buildings. The assessment should also include an examination of how and where decisions are made with a focus on how best to influence decisions.

We recommend that the DOE and other government agencies such as the EPA and national and regional energy organizations continue and increase their efforts to get the top 25 to 50 office developers to increase the energy performance of their buildings. These should take cognizance of the structure of the developer organizations, the decision-making and should have more of a one-to-one focus rather than a mass market focus.

The retail and service sub-market

Retail space can be divided into enclosed malls, strip malls, and other retail representing 14 percent, 23 percent, and 63 percent of retail and service space, respectively. Other retail space tends to be owner-occupied and relatively small in terms of square feet (mostly under 5,000 square feet). Enclosed mall and strip mall spaces tend to be larger and leased.

As many as 20 percent of regional malls that are mostly enclosed malls, are marginal and may need to be redeveloped or the land reused for other purposes in the next three to five years. Whatever the new uses of the buildings or land are, there is significant opportunity to influence the buildings in that space to be more efficient.

There are at least three key sets of players in the retail market. There are the large retail property owners, the top 50 of whom own the equivalent of 28 percent of enclosed mall and strip mall space. There are the large retail property managers, the top 50 of whom manage the equivalent of 32 percent of enclosed and strip mall space. And, there are the major retailers, the top 100 of whom have about \$1.2 trillion in revenues or about one-third of total U.S. retail revenues.

Most large retail property owners manage their own space. However, there are companies that specialize in retail property management who manage properties for investors or investor groups who are not in the business of managing property.

Large retail property owners lease much of their space to large retailers. The character of the space is typically spelled out in the lease documents. The property owner may develop the space to the retailer's specifications or the retailer may manage their own construction within the lease space. Some large retailers, for example, some grocery chains or supercenters, may own the land directly or take a ground lease and design and build a building to their own specifications. The important point is that for large retailers and/or large developers, much of the decision-making is centralized. That means that promoters of energy efficiency can potentially influence the efficiency of large amounts of space by working with a relatively small number of players at either the regional or the national

level. The DOE, EPA, and national and regional market transformation organizations can play important roles in this.

Decision-making for “other retail” is somewhat different. Other retail is usually small and owner-operated. This means that strategies attacking this market need to be locally focused using state and local resources. The DOE and EPA can help here by aiding in the development of effective local strategies for dealing with local players.

It is also important to realize that construction timelines for major retail projects are relatively short, roughly six months. Once construction has started, it is generally too late to influence projects because the specifications and the purchasing are largely complete. For major retail projects, it is probably important to influence the design basis used by the “image architects” for retail projects. The design basis is used in the negotiations for lease space and/or for laying out space once a lease is anticipated.

There are also opportunities to change the energy characteristics of a building when retail space is remodeled. Depending on the retail space, this may happen in six- to nine-year cycles.

Generally, people think of buildings as having a lifetime of half a century. In the current environment, especially for some retail buildings built in the last 20 to 30 years, it may be more appropriate to think of retail buildings as having a shorter lifespan that includes a refurbishing cycle of eight to 10 years and a total life span in the range of 20 to 30 years.

Our analysis suggests that efforts aimed at promoting efficient linear fluorescent lighting have been effective although there are clearly pockets in the strip mall and other retail sector that have yet to become efficient. It is likely that these are the small owner-occupied spaces. Other efficiency measures are common in more than half of the space represented by enclosed malls, but measures other than lighting have made only modest inroads into strip mall and other retail locations. Such measures are often found in locations representing less than 30 percent of the total square footage.

We recommend that the DOE assess the extent to which large national retailers are aware of and incorporate energy efficiency into their retail store designs. As part of the assessment we recommend that the DOE further develop its understanding of how decisions are made and implemented in these organizations.

We recommend that the DOE, EPA, and regional energy efficiency organizations develop strategies to promote more efficient technologies and designs that target large national retailers and their image architects and engineering firms. We recommend that the strategies have a one-to-one rather than a “mass market” focus. Large national developers who lease space to these retailers should also be targeted.

We recommend that the DOE and other government and national transformation organizations work with regional and local energy efficiency organizations to develop strategies, technology packages, and other resources that can be use by regional and local implementation organizations to foster energy efficiency among small independent re-

tailers. Such strategies should also target local developers, distributors, and contractors.

Food sales and service

There are five general types of businesses in the food sales and service sectors: growers and producers, food processing, wholesalers, food sales, and food services. There is some vertical integration among the businesses, especially between growers and producers and between wholesalers and food sales.

The food processing and beverage industry comprises approximately one-sixth of the U.S. manufacturing sector's activity. There is a fair degree of concentration in this industry. In 1998, the total sales for top 50 food and beverage companies was about \$250 billion.

Food wholesaling can be subdivided into merchant wholesalers, agents and brokers, and manufacturers selling direct. Merchant wholesalers account for a bit more than half of the \$589 billion in annual sales of wholesalers with the agents and brokers comprising about a fifth and manufacturers about one-quarter. Merchant wholesalers can be further divided into broad line distributors, specialty wholesalers, and miscellaneous wholesalers. Broad line wholesalers are being challenged by the large grocery chains and are responding by diversifying into the grocery market. There is a fair amount of concentration occurring in the broad line market. The top four firms in the broad line market increased their market share from 26 to 41 percent between 1987 and 1997, mostly at the expense of firms in the bottom part of the top 50.

Two large distributors, Sysco Corporation and U.S. Food Service, account for \$39 billion of the \$52 billion of sales by the top 10 vendors in the institutional market.

Food services

The number of restaurants has doubled to 858,000 in the last 30 years. Forty-three percent of restaurants are fast-food outlets, essentially chains and franchises. Thirty-nine percent are independent restaurants and lunchrooms.

The typical person over the age of eight eats 218 meals away from home annually. In addition, an increasing number of consumers are utilizing takeout. U.S. households now average one takeout meal per month. Grocery stores, in particular, are capitalizing on the trend toward takeout.

The top 25 food services chains with their 62 brands account for one-third of commercial food services sales and more than three-quarters (78 percent) of fast-food sales in this country. Within brands, a chain may own anywhere from 0 to 100 percent of the establishments. The median percent of chain-owned establishments for the top 25 food services chains is 23 percent. For the major food services chains, there are a relatively small number of decision makers who make decisions about equipment and set standards for a large number of establishments. These decisions carry over to franchisees through architectural services, planning, training, and quality control. The degree to which energy efficiency is currently addressed by the large chains is unclear. It is clear that these organizations are probably best addressed at a national or regional level.

Cooking is the largest end-use. Energy use for cooking is bound up with a host of issues including taste, food quality, health issues, labor requirements, etc. There is a broad range of interest groups that are interested in influencing these issues especially with respect to fast-food and takeout operations. The tradeoffs among these issues are likely to significantly influence energy use. Ultimately, chains are likely to deal with these issues through architectural designs and standards.

There are a large number of smaller independent restaurants and lunchrooms. These are regionally and locally owned and operated. Potentially, these establishments might benefit particularly from technology-specific efficiency improvements as well as holistic and/or integrated equipment solutions. However, these organizations may have to be addressed on an establishment-by-establishment basis. There may be general solutions that can be designed with regional and national resources but these solutions will have to be delivered to local establishments and their contractors through local and regional organizations.

Energy costs are a small percentage of overall costs but can substantially impact the overall profitability of food service operations especially the smaller independent operations.

Food sales

There are 158,000 food sales establishments in the U.S. Nearly 79 percent are convenience stores and gas stations, 20 percent are supermarkets, and one percent is wholesale clubs and military commissaries.

There is a high degree of concentration in the supermarket industry. The top 75 grocers sell 76 percent (\$519 billion) of the groceries sold in the U.S. annually. If Wal-Mart is included, the top five firms account for nearly 40 percent of those groceries. With this degree of concentration, decision-making with respect to facilities is heavily influenced by a relatively small number of national and regional managers. Investment decisions are usually driven by the need to increase market share, address marketing and presentation concerns, and to control operating costs.

There are 132 convenience chains in the U.S. The sales in convenience stores (\$291 billion) are less than half of those for food sales establishments. About 16 percent of these sales are for food and beverages.

Once again we see a high degree of concentration in this industry. The top 50 operators own or franchise 42 percent of all convenience stores. The level of control varies from strict control with specific standards to a fairly loose association of stores centered on a brand.

The changing demands of American consumers, notably the increased demand for time saving meals and meal preparation, have influenced the direction of this diverse market group. Four major trends are significantly altering its market structure and scope.

- There is an ongoing consolidation of market players.
 - There are increased mergers and acquisitions in several parts of the market including wholesaling.

- Supermarket chains are growing and increasing their market share. Wal-Mart is significantly impacting the food sales market.
- There is rapid growth in restaurant chains.
- There is a changing customer demographic that is fueling the demand for convenience dining including dining out and takeout.
- Nontraditional providers are entering the market
 - There is the emergence of the Wal-Mart supercenters
 - Wholesale clubs such as Costco and Sam's are growing.
 - E-commerce in grocery delivery and meal takeout is beginning to take hold.
- Capital and operating costs are rising
 - Margins are relatively thin in parts of this market and increases in energy costs can result in a reduction in profits
 - The cost of constructing new facilities is increasing.

In all parts of the food sales and services market, we have noted high degrees of concentration in ownership and/or franchising. For many of the players, this means centralized decision-making at the national or regional level and/or the use of standards and guidelines in building new facilities. For these players, commitments to energy efficiency will need to be made at high levels.

There are also many small independent players in these markets. These players will need to be approached on a one-to-one basis. For these players it will be important to leverage local resources such as contractors. It will also be important to provide information and tools that these players can use.

We recommend that the DOE assess which fast food chains and the extent to which fast food chains are incorporating energy efficiency into their building designs and kitchens. The assessment should also address how decisions are made for both corporate and franchisee operations.

We recommend that the DOE monitor and perhaps participate in efforts to improve the energy efficiency of kitchens in fast food chains and restaurants. The DOE may want to partner with trade associations, hospitality schools, and utilities such as PG&E that are already working in this arena.

We recommend that the DOE partner with other governmental agencies such as the EPA and FDA as well as national energy efficiency organizations to identify needs and develop strategies to promote more efficient technologies and designs that target the national fast-food chains, their image architects, engineering firms and franchisees. We recommend that the strategies have a one-to-one rather than a "mass market" focus.

We recommend that the DOE and other government and national transformation organizations work with regional and local energy efficiency organizations to develop strategies, technology packages and other resources that can be used by regional and local implementation organizations to foster energy efficiency among small independent restaurants. Such strategies might include working with franchisees of national fast-food chains that have a fair degree of independence and should also target local developers, distributors, and contractors.

We recommend that the DOE assess which national grocery chains and the extent to which national grocery chains are incorporating energy efficiency into their stores. We recommend that as a part of this assessment DOE obtain information on how decisions are made and implemented in these organizations.

We recommend that the DOE partner with other government agencies and national energy efficiency organizations to develop strategies to improve the efficiency of grocery stores run or managed by national chains or their franchisees. Such strategies might include a special technology focus on refrigeration end-uses. We recommend that the strategies have a one-to-one rather than a “mass market” focus.

The lodging sub-market

Lodging is one of the smallest commercial building sub-markets, accounting for approximately 175,000 buildings and four billion square feet of commercial floor space. The 175,000 buildings are found at 53,000 properties with more than 4.2 million rooms. In 2001, this sub-market had \$103.6 billion in sales and \$16.1 billion in pre-tax profits.

The lodging industry can be segmented by ownership and operation, target market, and location. Based on 1997 research, 38 percent of lodging in the U.S. is owner operated and managed; 36 percent is franchisee owned and operated; and 26 percent is independently owned and operated. The industry is price driven with large firms owning numerous brands that are oriented to specific price points and business and leisure markets.

The lodging industry offers a variety of services, lodging, food service, shopping, and entertainment. Some hotels and motels target the leisure market while others target the business traveler. In the leisure segment, sixty percent of the expenditures occur for items other than room charges. Thirty percent of the expenditures are for food. Nearly half of the expenditures in the business segment are for rooms. This is important because how one frames the energy efficiency message for the owner/operator will depend on the target segments and the price point that a particular brand serves.

The highest percentage of lodging locations is found along highways (42 percent) and in the suburbs (33 percent) with the remaining locations each accounting for 11 percent or less. If one compares the number of properties and rooms, it is clear that there are more rooms per property at urban, airport, and resort locations.

Forty companies in the U.S. own or franchise about 70 percent of the rooms. The top five firms own or franchise 43 percent of domestic lodging units and the top 10 firms own or franchise 57 percent of domestic lodging units. This indicates a very high degree of concentration and potentially represents a significant opportunity to influence energy efficiency in the lodging market.

While a single lodging firm may own several brands, brands are intended to differentiate the product. Those who promote energy efficiency across brands within a lodging firm may need to articulate different approaches and rationales for energy efficiency for each brand. Cost is always a driver but it may be more important at the low end and less important at the high end. Controls may be more important in high end facilities where the front desk might start pre-cooling a room when customers register.

Independents are more likely to be found in the budget category than in other categories when compared to chain affiliated independents. Also, independents are more likely to be found in highway locations. Finally, the units that independents own typically have fewer rooms than the units owned by chain affiliated operators.

However, independent hotels operate in every price class in this industry. Independent owners and operators dominate the resort class. They own 60 percent of the hotels and 56 percent of all guest rooms in resort areas. This is due to the large concentration of independently owned resorts in vacation destinations such as Orlando and Las Vegas.

Between 100 and 150 thousand new rooms were constructed annually during the period between 1987 and 1998 except for the period between 1991 and 1995 when the number of new rooms constructed was between 40 and 70 thousand annually. Thus, a significant number of rooms are built in any given year. The extended stay category now represents five percent of the total U.S. hotel room supply. It is projected to grow at an average of five percent per year through 2006.

Conversions occur when a property moves from one “flag” to another. The number of conversions is about three times the amount of new construction. Further, the rate of annual conversions is between seven and eight percent of the total number of rooms. While some conversions involve a change of signage and are cosmetic, other conversions involve extensive remodeling. Conversions are a target of opportunity for improving energy efficiency.

How the industry will fare in the next few years is highly dependent upon changes that are taking place in business. Seventy five percent of business travelers have switched to email, telephone, and teleconferencing as a substitute for face-to-face meetings. The evidence suggests that this trend will continue.

Water heating has the highest energy intensity (52,000 Btus per square foot annually) in the lodging sector. It is more than double the intensity of lighting. Buildings accounting for 83 percent of the floor space have central water heating supplying at least parts of buildings.

There is some evidence that efficient linear fluorescents have significantly penetrated this market.

The degree to which other types of efficiency measures may have penetrated the market is less clear.

We recommend that the DOE determine which lodging firms and what lodging brands may be incorporating energy efficiency into their building designs. The assessment should also address who makes decisions and how decisions are made for both corporate and franchisee operations.

DOE has already examined some of the technology needs in this area. We recommend that the DOE partner with other governmental agencies such as the EPA and FDA as well as national energy efficiency organizations to promote more efficient technologies and designs that target the national lodging firms, their brands, their image architects, engineering firms, and franchisees. The strategies should take cognizance of and incorporate the value propositions that are part of the branding for the chains. We recommend that the strategies have a one-to-one rather than a “mass market” focus.

We recommend that the DOE and other government and national transformation organizations work with regional and local energy efficiency organizations to develop strategies, technology packages, and other resources that can be use by regional and local implementation organizations to foster energy efficiency among regional and local franchisees. Such strategies might include working with local developers, distributors, and contractors.

The healthcare sub-market

There are about 100,000 buildings containing approximately three billion square feet of floor space in the healthcare sub-market. The healthcare sub-market is divided into the inpatient and outpatient markets. This division of the market is important for three reasons. In terms of square footage, the inpatient market (1.9 billion square feet) is larger than the outpatient market (1.1 billion square feet). However, there are 10 times as many buildings in the outpatient market as in the inpatient market. The second is that energy use intensities in the inpatient market are three to four times the energy intensities in the outpatient market. Thirdly, the long-term trend is for services to move from the inpatient to the outpatient market. Thus, in future years, the inpatient market is likely to continue to shrink while the outpatient market will grow.

There is some concentration of ownership in the inpatient market but not to the same degree as we have seen in other commercial building markets. In general, the market is made up of a mix of public and private and profit and not-for-profit ownership. There are large systems with numerous buildings and there are many smaller community hospitals, some of which are independent and some of which are banding together in small numbers in an effort to survive.

One of the key trends in this market is the movement from inpatient services to outpatient services. One of the drivers of this has been the formation of health management organizations to contain costs and deliver healthcare outside of the inpatient structure. Another driver of the movement from inpatient to outpatient services has been advances in

equipment, treatment, and medicines which have made it possible to deliver medicine outside the hospital setting. What this seems to mean is that while there will still be a need for acute care facilities, the number and scale of these facilities will continue to diminish. It also means that care will increasingly be delivered in office and home settings.

Outpatient care includes nursing home and assisted living care. Historically, nursing and assisted living care have been provided by small local independent operators. Many of these operators are now leaving the business because they are undercapitalized and because of the focus on standards and quality of care. Increasingly, the care for seniors is being assumed by larger, better capitalized organizations that are providing a range of care options from independent living to long-term sub-acute care. One group of players entering this market is lodging companies.

In terms of energy use, it appears that the inpatient market has already done a fair amount with lighting and perhaps other end-use technologies. The outpatient market appears to be less advanced in this regard. One of the difficulties may be that the inpatient market is dealing with older buildings with numerous additions. When evaluating inpatient buildings, energy engineers frequently point out that there are potentially large savings from rationalizing systems in addition to using more efficient technologies.

There are some clear strategies for working with players in this market. It is clear that there is a need to work with the larger players in the inpatient market. There are some large national for-profit players but many of the large players are regional and local not-for-profit organizations. The smallest organizations and the independent players are probably best dealt with at regional and local levels.

The outpatient market represents an entirely different setting. Much of the care in this sector will be delivered in office settings involving lease space. Thus, the efficiency of this part of the sub-market will depend on what is being done in the office market. The other major part of the outpatient market is the emerging senior housing market. There are really two sets of targets here. The larger, better capitalized players will be building new senior housing. These players will increasingly be national organizations and of course, not-for-profit organizations that have long been players in this market. These players may be addressed through larger national strategies. The other group will be the smaller and mostly independent players. This market will have to be addressed at state and local levels.

We recommend that the DOE assess the extent to which the large for-profit and the major not-for-profit organizations are addressing energy efficiency issues.

To the extent that they are not already being targeted, we recommend that the DOE, EPA, and regional energy efficiency organizations develop strategies to promote more efficient technologies and designs among the large national for-profit hospital chains and the large not-for-profit chains as well. When dealing with the nonprofit chains, that are frequently regional, we recommend that the DOE partner with regional organizations. We recommend that the strategies have a one-to-one rather than a “mass market” focus.

We recommend that the DOE and other government and national transformation organizations work with regional and local energy efficiency organizations through mechanisms such as Rebuild America to develop strategies, technology packages, and other resources that can be used by regional and local implementation organizations to foster energy efficiency in community hospitals. Such strategies should also target local developers, distributors, and contractors.

We recommend that the DOE, EPA, and regional energy efficiency organizations develop strategies to promote more efficient technologies and designs among the large national organizations, developers, hospitality organizations, and others who are developing housing for the seniors market. We recommend that the strategies have a one-to-one rather than a “mass market” focus.

The warehouse sub-market

As in other markets, we found a few large players with a large amount of floor space. The smallest of the top 50 large players has about four million square feet of warehouse space. There may be many players with very large amounts of space that have slightly less than four million square feet. We suspect that most of this is private space used to store goods rather than public or contract space.

There are also some large players who provide cold storage. We may see increases in the amount of cold storage in response to some of the trends in the food sales and food services industries such as the growth in eating out, takeout, the demand for convenience foods, and the movement to larger food sales operations.

One of the key findings in this chapter is that the role of warehousing is changing. Suppliers, manufacturers, and retailers are working to compress the supply chain, that is, reduce the amount of time that goods are in the chain. Suppliers, manufacturers, and retailers are also attempting to reduce the amount inventory that is in place. The goal is to have just the goods in place that are needed. This means that increasingly, the delivery of goods is time critical.

The functions of warehouses are changing as well. Historically, warehouses were used as way stations for goods until they were needed. Warehouses are now becoming logistics centers. Warehouses are adding value to products by serving as locations where components of product are brought together, where quality testing is completed, and where goods are repackaged before moving on. Warehouses are also serving as centers for sorting and dealing with returned merchandise.

Warehouses are being redesigned to accommodate both the speed and flexibility that manufacturers and consumers require. This shift in operations is resulting in new warehouse designs such as narrower square footage between doors, larger parking areas for trucks, improved information technology to monitor inventory flows, and the expansion beyond “traditional” warehousing functions to goods processing. An important implication of this is that energy intensity in warehouses may begin to rise and/or warehouses may begin to morph into facilities that do not store goods but process goods.

One thing that is clear is that logistics is becoming an increasingly important discipline. More and more manufacturers and retailers are focusing on their core businesses and outsourcing the movement of their goods to logistics companies. The alternative is to develop the in-house logistics expertise.

The energy intensity of warehouses is low, less than 40,000 Btus per square foot annually. However, these data are now about eight years old. Many of the changes in logistics that we have seen have occurred in the last eight years. Thus, we may see a rise in energy intensity. Space heating and lighting are the main energy uses in warehouses.

We recommend that the DOE monitor changes in the warehousing sector, particularly the shift to logistics, and the impact that may have on energy consumption.

The education sub-market

The education sub-market is quite dynamic. Enrollments are increasing in K-12 schools, colleges, and universities throughout the United States.

The major divisions within the education market are the K-12 and post-secondary markets. Within the K-12 market, public school enrollments are five times those of private enrollments. Within the public sector, there are a few hundred school districts with large enrollments and large numbers of buildings. These districts represent particularly good targets for energy efficiency because of the number of buildings and the number of new buildings that they are constructing. In the private K-12 market, there are religious institutions, such as the Catholic Church, which have large numbers of schools. These institutions represent an important target of opportunity as well.

There are several trends that could lead to increased energy consumption in K-12 schools in the next several years. These trends include longer school hours, clustering of buildings and sharing of resources, year-round classes, and more individualized instruction.

Computers and the Internet have now penetrated almost all K-12 schools. There was concern that computers might increase energy consumption directly, and indirectly by increasing the space needed in classrooms. The shift from desktops to laptops and the introduction of wireless technologies is likely to substantially mitigate changes in space requirements as well as to mitigate power consumption. However, computer technology is likely to change the way content is delivered and classrooms are organized resulting in changes in the physical design of schools. Computer technology may also result in some amount of instruction being moved to homes and other locations.

Depending on how you count, there are two or three important trends that will change post-secondary educational institutions. One of these is the rise of private for-profit institutions, and the second and third are the impact of computer technology and networks and the rise of “virtual institutions.”

The shift to for-profit and on-line educational facilities will influence the types and kinds of buildings that are used to deliver educational services both on and off campus. On-campus education may drift from the lecture model to a model where content is delivered on-line. Face-to-face contact with faculty may be displaced by electronic contact. Labo-

ratory work may be done in computer based virtual laboratories. Off-campus education is already being delivered in nontraditional venues such as office buildings and the home. Employers are offering on-site courses to their employees. These trends will continue and accelerate. This, too, will influence the nature of residential education.

The evidence we have assembled suggests that post-secondary institutions, perhaps most typically large diverse undergraduate and graduate institutions, have some of the highest end-use intensities in the commercial sector. Technologies with the potential to save energy have penetrated campuses but may be being offset by construction of larger more complex campus buildings, continued use of older structures, and an increase in the types and number of appliances used by faculty and students. Energy conservation and efficiency messages should promote the benefits of operating energy efficient computers and related equipment, and promote the installation of lighting and space conditioning technologies that offer comfort and savings. This also points to a need to continue to develop comprehensive approaches to energy efficiency such as those being encouraged by Re-build America, including identifying energy usage savings in classrooms, science labs, and dormitories.

Moreover, the increased reliance on Internet access means that students may be learning more often in nontraditional places, such as dorm rooms, offices, and at home. This trend will shift resources away from the “bricks” of educational facilities and focus more on ways to enhance and adapt telecommunications and computer technologies to meet the needs of the rising student population in the United States.

An articulated and integrated approach to energy efficiency in commercial buildings

Historically, the DOE’s approach to energy efficiency in commercial buildings has been to focus research and development on promising technologies that have the potential to impact demand and energy use. Similarly, utilities and other implementation organizations have focused on available technologies and have attempted to penetrate the various sub-markets with them. By and large, the marketing strategies have been one-to-many efforts that have relied heavily on “broadcast” methods to communicate with target audiences. While these strategies have had some effect, there are more effective ways to communicate with target audiences. In this regard, this study documents several important points:

The commercial building market is a heterogeneous market comprised of a number of sub-markets that can be further segmented. This study makes a substantial contribution in understanding these markets and segments but much additional work is needed. In particular, it is important to know in which sub-markets and segments and to what extent players may already be addressing efficiency issues, and in which sub-markets and segments efficiency may be lagging.

We also know that the sub-markets and segments have different technological needs, different value propositions, and different future prospects. Energy efficiency technologies and programs that are keyed to these needs, value propositions, and prospects are likely to be much more successful than broad scale efforts with no specific target in mind.

For both new construction and remodeling and renovation, financing sets the constraints within which developers, owners, and building professionals can act. This has two important implications. The first is that energy efficiency needs to be on the agenda prior to financing so that the first costs of efficiency can be dealt with. A second implication is that owners and developers need to understand the value of energy efficiency in terms of value propositions that make sense to them.

Within nearly every sub-market, there are two sets of players, the large national owners and chains, and the smaller more local and independent players. The large national players often have standards and guidelines that they use nationwide and relatively small teams of buildings professionals who design, manage, and build buildings for them. National leadership and national level efforts are needed to influence these players. The good news is that one may only need to influence a few hundred or fewer players in a given sub-market or segment in order to have a significant impact on energy efficiency in commercial buildings. The other piece of the news is that in order to be really effective in penetrating these markets, it is important to selectively target these players a few at a time and work with small groups and through professional associations on a one-to-one basis. This is important for understanding energy efficiency needs in order to design future generations of technologies, to deliver technologies that will be adopted, and to facilitate the adoption of technologies. Federal agencies, such as the DOE, and national energy efficiency organizations need to partner with each other to accomplish these ends.

The needs of local and independent players must also be addressed. The technologies that are important to them may be somewhat different than for the larger players, and the resources that they have available to them may be more constrained. Within sub-markets and segments, the needs of small players are quite similar. Effective strategies and resources for addressing the efficiency and marketing needs of these players can be developed through the cooperation of state and local governments, local and regional energy efficiency organizations, utilities, and Federal agencies. The job of selling and implementing energy efficiency to these players is likely to be most effective if it is based on one-to-one relationships at the local level.

In the end, energy efficiency and conservation will be adopted much more rapidly if two things happen. The first is to articulate the similarities and the differences in technological needs and the structure and organization of sub-markets and segments so that technologies and implementation efforts match and meet the needs of the players. The second is to integrate efforts across Federal, state, public, and private organizations focusing on large players with high concentrations of buildings within the sub-markets. A separate integrated effort that targets more local and independent players in those same markets is also needed.

Appendix A

Description of CBECS Building Types

In the Commercial Buildings Energy Consumption Survey (CBECS), buildings are classified according to principal activity, which is the primary business, commerce, or function carried on within each building. Buildings used for more than one of the activities described below are assigned to the activity occupying the most floor space at the time of the interview. Thus, a building assigned to a particular principal activity category may be used for other activities in a portion of its space or at some time during the year.

In the 1999 CBECS, respondents were asked to place their building into a sub-category that was a more specific activity than has been collected in prior surveys. This was done to ensure the quality of the data; after data collection, the subcategories were combined into these more general building categories, which are consistent with prior CBECS surveys.

Building Type	Description	Sub-categories
Education	Buildings used for academic or technical classroom instruction, such as elementary, middle, or high schools, and classroom buildings on college or university campuses. Buildings on education campuses for which the main use is not classroom are included in the category relating to their use. For example, administration buildings are part of "office," dormitories are "lodging," and libraries are "public Assembly."	<ul style="list-style-type: none"> • preschool or daycare • elementary, middle, or high school • college or university
Food Sales	Buildings used for retail or wholesale of food.	<ul style="list-style-type: none"> • grocery store or food market • gas station with a convenience store • convenience store
Food Services	Buildings used for preparation and sale of food and beverages for consumption.	<ul style="list-style-type: none"> • restaurant bar • fast-food chain • cafeteria
Healthcare (Inpatient)	Buildings used as diagnostic and treatment facilities for inpatient care.	<ul style="list-style-type: none"> • hospital or other inpatient healthcare • mental health institution • inpatient rehabilitation
Healthcare (Outpatient)	Buildings used as diagnostic and treatment facilities for outpatient care. Doctor's or dentist's office are included here if they use any type of diagnostic medical equipment (if they do not, they are categorized as an office building).	<ul style="list-style-type: none"> • doctor's or dentist's office (see previous column) • clinic or other outpatient healthcare building • outpatient rehabilitation • veterinarian's office
Lodging	Buildings used to offer multiple accommodations for short-term or long-term residents, including skilled nursing and other	<ul style="list-style-type: none"> • hotel motel, inn, or resort • retirement home, shelter, orphanage, or children's home

	residential care buildings.	<ul style="list-style-type: none"> • convent or monastery • dormitory, fraternity, or sorority • nursing home, assisted living, or other residential care building • half-way house
Mercantile (Retail Other Than Mall)	Buildings used for the sale and display of goods other than food.	<ul style="list-style-type: none"> • car dealership or showroom • alcoholic beverage store • store that rents items such as videos, equipment, or vehicles • free standing store such as a department, furniture, clothing, hardware, drug store, or bookstore
Mercantile (Enclosed and Strip Malls)	Shopping malls comprised of multiple connected establishments.	Enclosed mall or strip shopping center
Office	Buildings used for general office space, professional office, or administrative offices. Doctor's or dentist's office are included here if they do not use any type of diagnostic medical equipment (if they do, they are categorized as an outpatient healthcare building).	<ul style="list-style-type: none"> • bank or other financial institution • doctor's or dentist's office (see previous column) • government office administrative or professional office • research and development building
Public Assembly	Buildings in which people gather for social or recreational activities, whether in private or non-private meeting halls.	<ul style="list-style-type: none"> • theater, cinema, sports arena, casino, or night club • gymnasium, health club, bowling alley, or other recreational sports facility • social meeting center, meeting hall, or convention center • library or museum • transportation terminal • funeral home • broadcasting studio
Public Order and Safety	Buildings used for the preservation of law and order or public safety.	<ul style="list-style-type: none"> • jail, reformatory, or penitentiary • courthouse or probation office • fire or police station
Religious Worship	Buildings in which people gather for religious activities, (such as chapels, churches, mosques, synagogues, and temples).	
Service	Buildings in which some type of service is provided, other than food services or retail sales of goods	<ul style="list-style-type: none"> • beauty parlor or barber shop • car wash, copy center, dry cleaner or Laundromat • gas station • kennel • photo processing shop • post office or postal center • repair shop

Warehouse and Storage	Buildings used to store goods, manufactured products, merchandise, raw materials, or personal belongings (such as self-storage)	<ul style="list-style-type: none"> • refrigerated warehouse • non-refrigerated warehouse
Other	Buildings that are industrial or agricultural with some retail space; buildings having several different commercial activities that, together, comprise 50 percent or more of the floor space, but whose largest single activity is agricultural, industrial/ manufacturing, or residential; and all other miscellaneous buildings that do not fit into any other category.	<ul style="list-style-type: none"> • airplane hangar • crematorium • laboratory • agricultural with some retail space • manufacturing or industrial with some retail space
Vacant	Buildings in which more floor space was vacant than was used for any single commercial activity at the time of interview. Therefore, a vacant building may have some occupied floor space. No subcategories collected, but a question was asked to determine whether the building was completely vacant.	

