Environmental Implications of the Foodservice and Food Retail Industries

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ABSTRACT

The growing size and importance of service sector industries in the U.S. economy raises questions about the suitability of the current environmental management system to deal with perhaps a changing set of environmental concerns. This paper analyzes the environmental impacts associated with the activities undertaken and influenced by two service sector industries—foodservice (e.g., restaurants) and food retail (e.g., grocery stores). This paper is not a definitive analysis of the magnitude of the environmental effects of these industries, but is intended to be a comprehensive survey of the types of environmental implications—positive and negative—of these two service sectors.

The foodservice and food retail industries are components of a larger industrial system, the food marketing system, that extends from the production of food to the marketing of food products to consumers. The U.S. foodservice industry comprises an estimated 831,000 individual establishments, employs an estimated 11 million people (about 8.6% of the U.S. workforce), and is expected to have total sales of $376 billion in 2000. The U.S. food retail industry encompasses approximately 126,000 grocery stores, employs approximately 3.5 million people (about 2.7% of the U.S. workforce), and had sales totaling $449 billion in 1998.

For this analysis, we use a simple conceptual framework that segregates the environmental impacts of these industries into three categories: direct, upstream, and downstream. We conclude that, while the direct environmental impacts (e.g., energy use, solid waste generation; air and water emissions; food safety concerns; refrigerants) of these industries are important to recognize and address, opportunities also exist for these industries to address their upstream and downstream environmental impacts.

Key Words: foodservice; food retail; service sector; environmental impact analysis; sector environmental profile

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PREFACE

This paper analyzes the environmental impacts associated with the foodservice and food retail industries, with a focus on the activities of restaurants and grocery stores. The paper is not a definitive analysis of the magnitude of the environmental effects of these industries, but is intended to be a comprehensive survey of the types of environmental impacts—positive and negative—of these two service sectors.

A small workshop was held at Resources for the Future (RFF) in January 1999 to discuss the environmental implications of the service sector. The diverse attendees, including representatives of government, industry, environmental groups, and academia, provided a variety of perspectives on our research. A small breakout group devoted its attention to the foodservice sector and identified a number of important issues confronting the industry. We would like to thank participants in the workshop for their insights and contributions to this research. A number of individuals also provided valuable comments on a previous draft of this paper. In particular, the authors would like to thank Braden Allenby, Tom Beierle, Andrea Clarke, and David Rosenberg.

This study is one in a series of analyses conducted by RFF's Center for Risk Management to better understand the environmental effects of service sector activities and the implications for environmental management strategies. In addition to the foodservice and food retail industries, the other service sectors examined were health care (Davies and Lowe, 1999) and tourism (Davies and Cahill, 2000). This research was sponsored by the U.S. Environmental Protection Agency's Emerging Strategies Division (ESD) under cooperative research agreements #821574 and 826527. We are grateful to Dan Fiorino, Joe Reinert, and Lutrician Booth of ESD for their advice and support.

EXECUTIVE SUMMARY

Service industries represent a growing component of the U.S. economy, currently accounting for approximately three-quarters of the nation's Gross Domestic Product and total employment (U.S. Census Bureau, 1998; U.S. Bureau of Economic Analysis, 1998). This fact has caught the attention of the environmental policy community (Allenby, 1997; Guile and Cohon, 1997; Rejeski, 1997; Graedel, 1998; Ellger and Scheiner, 1997; Grove, et al., 1996). Analysts are beginning to inquire about the suitability of the current environmental regulatory and management system—one designed to address the impacts of goods-producing industries—to deal with perhaps a new and different set of environmental challenges posed by service industries. Conclusions regarding how (or whether) pollution control and natural resource management should be modified are contingent upon gaining a better understanding of the environmental impacts of service industries.

This paper represents a step in this direction through its analysis of the environmental implications of two service industries—foodservice (e.g., restaurants, school cafeterias) and food retail (e.g., grocery stores). The U.S. foodservice industry comprises an estimated 831,000 individual establishments, with total sales in the industry expected to reach $376 billion in 2000. The foodservice industry is among the largest employers in the nation, with an estimated 11 million people (about 8.6% of the U.S. workforce) currently working in foodservice establishments (NRA, 2000). The U.S. food retail industry (this paper focuses on grocery stores) comprises approximately 126,000 grocery stores and employs 3.5 million people (about 2.7% of the U.S. workforce) (FMI, 1999). Total sales from grocery stores constitute the largest of any other industry in the food marketing system, totaling $449 billion in 1998 (Progressive Grocer, 1999).

The analysis classifies the environmental impacts of the foodservice and food retail industries into three categories: (1) *direct* environmental impacts, which refer to the effects of the service provision itself (e.g., energy use, air and water emissions, solid waste generation); (2) *upstream* environmental impacts, which refer to the influence foodservice and food retail companies have over their supply chains and the impacts of their upstream, non-retailing activities; and (3) *downstream* environmental impacts,

which refer to the linkages between operators in these industries and consumer behavior. The primary impacts associated with each category are summarized below.

DIRECT ENVIRONMENTAL IMPACTS

This paper considers six main categories of direct environmental impacts. Each is summarized below.

Energy Consumption

Total energy use in commercial foodservice and food retail operations accounts for less than one percent of total domestic energy consumption (DOE/EIA, 1999; DOE/EIA, 1998). In 1995, total energy consumption in commercial foodservice was 332 trillion Btu (British thermal units) and 137 trillion Btu in food retail, accounting for approximately 6.2% and 2.6% of total commercial building energy consumption, respectively. In commercial foodservice, the most significant uses of energy are for cooking (nearly a third of the total), lighting, and refrigeration; in food retail, the most significant uses of energy are for refrigeration (over half the total), followed by lighting and space heating. Though the foodservice and food retail industries are responsible for only a small proportion of overall U.S. energy consumption, foodservice and food retail operations are the first and third most intensive energy users in the commercial sector, respectively (DOE/EIA, 1998). The energy intensity of these industries suggests that there are substantial opportunities to reduce the energy usage of these industries, thereby simultaneously reducing the associated environmental impacts.

Solid Waste Generation

Foodservice and food retail operations generate two main categories of solid waste—food waste and packaging materials—both of which constitute significant portions of the overall U.S. municipal solid waste stream. In its most recent analysis, the U.S. Environmental Protection Agency (EPA) found that 21.9 million tons of food waste was generated in 1997, representing the third largest category of solid waste (10.1% of the total, by weight) (EPA, 1999d). A second recent study, conducted by the Economic Research Service (ERS) of the U.S. Department of Agriculture (USDA), estimated total food wastes to be much higher. According to their estimates, in 1995, 96.3 billion pounds

(48.2 million tons) of food was lost by food retailers, foodservice operators, and consumers. Of this total, 90.8 billion pounds (45.4 million tons) of food was lost by consumers and foodservice outlets and 5.4 billion pounds (2.7 million tons) of food was lost at the retail level (Kantor, et al., 1997). The primary reason for the discrepancy in findings is that the ERS defines food losses as all edible food, whereas EPA limited its analysis to that of food waste generated as part of the municipal solid waste stream.

With respect to packaging materials, corrugated cardboard and paper are generally the most significant type of solid waste generated by foodservice establishments. Other important types generated by foodservice operations include glass, metals, and plastics. There are no industry-wide data on the proportion of these materials found in the municipal solid waste stream that can be attributed directly to foodservice operations. With regard to food retail operations, a study conducted in 1993 found that the industry generated 25.4 million tons of grocery packaging. In that year, grocery packaging accounted for more than one-third of the total containers and packaging found in the municipal solid waste stream (Franklin Associates, 1995). The types of packaging waste generally found in the waste stream of food retail operations are corrugated cardboard, paper, plastics, steel, aluminum, glass, and wood.

Air Emissions

Foodservice and food retail operations are themselves generally not significant sources of air pollution. No data are available on the portion of total emissions of specific pollutants that can be ascribed directly to the foodservice and food retail industries, and individual operations generally do not require federal permits under the National Ambient Air Quality Standards (NAAQS) program of the Clean Air Act. The one exception is emissions from vent hood systems of foodservice equipment which are regulated as part of the NAAQS program (Mason, 1996). In 1997, the South Coast Air Quality Management District became the first regional air board to impose regulations on restaurant air emissions (Ruggless, 1998), requiring users of certain foodservice cooking equipment to install pollution control measures.

Indoor air pollution is also an issue for foodservice operations, especially with respect to environmental tobacco smoke (secondhand smoke). One study concluded that employees of the foodservice industry face an increased risk of lung cancer from

exposure to environmental tobacco smoke. This study found that levels of environmental tobacco smoke in restaurants far exceeded that of residences. Furthermore, the epidemiological evidence suggested that there may be up to a 50% increase in the lung cancer risk among restaurant waiters that, in part, is attributable to environmental tobacco smoke exposure in the workplace (Siegel, 1993).

Water Emissions

Foodservice and food retail operations are point sources of water pollution, but are generally too small to trigger the permitting requirements of the National Pollution Discharge Elimination System of the Clean Water Act. Restaurants and supermarkets usually discharge directly into municipal sanitary sewer systems. Though no industry-wide data are available regarding water emissions from foodservice establishments, the primary concerns to wastewater treatment facilities are typically grease and food wastes. Concerns about foodservice discharges to local sewer systems have led some cities to impose surcharges on water use and pass regulations limiting the use of commercial garbage disposals.

Food Safety—Foodborne Diseases

The latest data from the Centers for Disease Control and Prevention (CDC) indicates that 76 million people are sickened, 325,000 are hospitalized, and 5,000 die annually from food poisonings (Mays, 1999). Recent studies, furthermore, indicate that foodborne illnesses are on the rise (GAO, 1996; Collins, 1997; Tauxe, 1997). While food is often tainted at early stages of the food marketing system, either at the level of production (e.g., *E. Coli* contamination of fresh produce) or processing (e.g., *Listeria* contamination of processed beef), foodborne illnesses can also stem from the transmission of foodborne pathogens at the level of foodservice and food retail operations. The most common outbreaks of foodborne illnesses are attributed to bacterial pathogens.

There is no official estimate of how many of the 76 million estimated annual cases of foodborne illnesses result from eating in restaurants and other foodservice operations (DeWaal and Dahl, 1996). The CDC (1996), however, indicates that, from 1988-1992, 40% of all reported outbreaks were traced to food eaten at restaurants,

delicatessens, and cafeterias. There are also no precise estimates of how many foodborne illnesses stem from food retail operations, though considerable opportunities exist for the mishandling of food in this industry as well, especially considering the trend toward increased foodservice within supermarkets (FMI, 1999).

Refrigerants

Chlorofluorocarbons (CFCs) are synthetic chemicals used as cooling agents in many refrigeration and cooling systems including refrigerators, freezers, chillers, and air conditioners. Though these systems are found in other industries, foodservice and food retail operations represent the largest commercial users of refrigeration, 23.6% and 39.0%, respectively, and also are significant commercial users of cooling, 7.4% and 2.6%, respectively (DOE/EIA, 1998). The EPA regulates the use of CFCs to ensure U.S. compliance with the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer and its subsequent amendments. Foodservice and food retail operators have different options on how to deal with CFC-refrigerants—recycle refrigerants, retrofit equipment for CFC-free compounds, or replace equipment with CFC-free equipment (Mason, 1996). The extent to which foodservice and food retail operations have begun to use alternative refrigerants, however, is unclear.

UPSTREAM ENVIRONMENTAL IMPACTS

The foodservice and food retail industries play a key intermediary role in the food marketing system. These industries function as arbiters or gatekeeper between producers and processors at one end and consumers at the other end through their determination of which foods to serve or offer on their shelves (Connor and Schiek, 1997). In this role, the foodservice and retail food industries are in a strong position to influence upstream environmental activity through what is often referred to as "green supply" or supply chain environmental management. Enhanced by some important trends reshaping the overall food marketing system—namely, increased consolidation and market concentration, shifts to higher levels of vertical coordination, and industry-wide efforts to improve the efficiency of supply systems—a multitude of opportunities exist for foodservice and food retail companies to affect upstream environmental performance. A set of key opportunities is summarized below.

Vertically Integrated Companies

Many foodservice and food retail companies are vertically integrated and perform functions in the food marketing system other than retailing. With the control that comes from ownership, these companies can make unilateral decisions to improve environmental performance in these upstream operations. Vertical integration is more common in the food retail industry than in the foodservice industry, particularly with respect to distribution and manufacturing.

Self-distribution by grocery retailers has become standard in the industry with most stores at least somewhat backward vertically integrated into warehousing and distribution. With a few exceptions, the top 50 food retailers (in terms of sales) are fully integrated into grocery wholesaling, and the leading grocery companies have considerable investments in warehouses, trucks, and trailers. The most significant environmental concern arising from these operations is air pollution, both in terms of the concentration of air pollutants around supermarket distribution centers and the emissions from trucks. Of particular significance is the exhaust from diesel-fueled trucks, which has been noted to be a contributor to ground-level ozone (smog) and is associated with a multitude of adverse health and welfare effects (EPA, 1996).

The other major type of vertical integration in the food retail industry is self-manufacturing. Many of the large, national chain grocery companies (and some smaller companies) have moved upstream into manufacturing, operating many different kinds of facilities including bakeries, dairy processing facilities, and beverage facilities. Food retail companies engaged in self-manufacturing are in a position to improve the environmental performance of these operations. The most significant environmental impacts of these operations include the emission of volatile organic compounds (VOCs) and high biological oxygen demand (BOD) water effluent from bakeries (EPA, 1998a; Carawan, 1996a), high water usage from dairy processing facilities (Carawan, 1996b), and toxic byproducts from meat packing plants (EPA, 1998b) and other company-owned packaging and processing facilities. Though industry-level data do exist regarding the environmental impacts of these manufacturing operations, the share attributable to self-manufacturing grocery retailers is unclear.

Contracts

Contracts represent another vehicle that can be used to "green" the supply chain. Contractual arrangements are an intermediate form of vertical coordination and are quite prevalent in the food marketing system as a mechanism enabling companies to coordinate supply and demand. Among the important examples of contracting in the foodservice and food retail industries include agreements between a franchiser and individual restaurants, restaurant chains and food manufacturers, and food retailers and food manufacturers. Though the dynamics of each type of contractual arrangement differ, in each situation the participating foodservice or food retail company is in an auspicious position to integrate environmental criteria into the agreement. In other words, the company can negotiate product specifications or process guidelines with the environmental implications in mind. Examples include requiring that a franchisee use recycled-content packaging or requiring food manufacturers of private label products to maintain the highest food safety standards. The very pervasiveness of contractual arrangements makes them a potent lever for foodservice and food retail companies to use to promote improved upstream environmental performance.

Strategic Alliances

Strategic alliances, also known as vertical alliances, represent another prevalent piece of the supply chain. Serving a similar function as contracts, strategic alliances are collaborative efforts by buyers and sellers to reduce their risk and transaction costs, though each maintains its separate operations and independent identities (Kohls and Uhl, 1998; Sporleder, 1992). Common examples of strategic alliances in the food marketing system are those between foodservice companies and foodservice distributors. Many fast food companies, for instance, have entered into strategic alliances with specialized foodservice distributors that serve as sole suppliers of their restaurants in a given geographical area. Foodservice companies that have entered into these types of strategic alliances are in strong positions to influence which products their foodservice distributors supply, including their environmental attributes.

Wholesaler Supply Channel

The wholesaler supply channel is another important part of the supply chain, and represents the conventional manner in which food products move through the food

marketing system. In this channel, manufacturing (or packing), distribution, and retailing are performed by three separate firms; products flow from manufacturers to distribution centers operated by wholesalers, and then on to individual foodservice and food retail establishments (ECR Performance Measures Operating Committee, 1994). Foodservice operations, more so than food retail operations, rely heavily on this distribution channel.

The opportunity for foodservice and food retail operators to influence upstream environmental behavior through the wholesaler supply channel is considerable, based on the fact that individual restaurants and stores have the ultimate authority to determine which products they offer to their customers. Purchasing decisions are based on factors such as cost, quality, availability, and consumer demand, but it is within an individual operator's discretion to expand these decisions to include environmental criteria (e.g., using organic ingredients in meal preparation, shelving "green" products).

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To illustrate the wide variety of opportunities that foodservice and food retail operators have to affect upstream environmental issues through the supply chain, three issues—pesticides, animal waste, and food safety—are considered in detail in the paper. In each case, opportunities exist for these industries to use their leverage for environmental stewardship.

DOWNSTREAM ENVIRONMENTAL IMPACTS

The intermediary position of foodservice and food retail companies between those responsible for the production, manufacturing, and distribution of food products and the consumers that purchase these food products provides similar opportunities to influence downstream environmental performance. The retailer-consumer interface is characterized by two-way communication: consumers express their preferences through their purchasing decisions and retailers provide information about the products they offer. Both components of this interface are explored in their environmental contexts in this analysis, as is summarized below.

Responses to Changes in Consumer Preferences

The impact of consumer preferences on the food products offered by foodservice and food retail operators is most evident in terms of changing consumption patterns caused by demographic changes in the U.S. population, changes in economics and the value of time, and scientific advances that have led to increased knowledge about food and its relationship to health and nutrition (Carlson, et al., 1998; Standard & Poor's, 1999; Kinsey, 1994; Manchester, 1992). Collectively, these changes have had significant implications for food markets, such as the development of products that reflect environmentally responsible production (e.g., organic foods, recycled-content packaging).

Studies indicate that 6-7% of consumers consider a product's environmental impact as a primary factor in their buying decision. For most consumers, though, the environmental attributes of food products constitute only one of many criteria (e.g., price, quality, brand recognition, convenience, taste, appearance, availability, cleanliness) considered in their purchasing decisions and, if considered, serve primarily as a differentiator or "tie-breaker" once basic expectations have been met (FMI, 1997c; Speer, 1997).

The best evidence of the impact of consumer preferences for environmentally friendly food products is the increased popularity of the natural foods market generally, and the organic foods market, specifically. While natural foods presently constitute a relatively small part of the overall retail foods market, accounting for only $5.5 billion in total retail sales in 1997, the natural foods retail market has had annual growth of 25% over the past seven years and, according to some predictions, will by 2008 constitute nearly 10% ($60 billion) of the total retail foods market (Richman, 1999). An important component of the overall natural foods market, and a general proxy for consumer demand for environmentally friendly food products, are organic foods. In terms of retail sales, organic food sales equaled $4 billion in 1997, with sales predicted to be approximately $6 billion by the year 2000 (Brandt, 1998; Organic Trade Association, 2000). Though this number represents only a minor segment of the market, there are indications that the organic foods market will continue to grow (FMI, 1997c; Glaser and Thompson, 1999).

A key constraint on expansion of the natural and organic foods markets is the limited price premium (estimated to be about 4.5% in 1996) consumers are willing to pay for these types of food products (Speer, 1997). Another potentially important factor may be the general lack of consumer knowledge of the environmental impacts associated with the production and manufacture of many food products. The opportunity for foodservice and food retail operators to provide this kind of information is discussed next.

Information Provision

Through shelf and menu offerings, the foodservice and food retail industries in large measure control the choices of meals and products available to consumers. As retailers, these industries are also well-positioned to provide information to their consumers about the meals and products they sell. Foodservice and retail food operators can inform their customers about the environmental attributes of food products, thereby arming them with information to use, if they so choose, in their purchasing decisions.

Communicating environmental information about food products is difficult. However, in addition to advertising and labeling, which generally are done by food manufacturing companies, there are some techniques that fall under the purview of foodservice and food retail operators that show promise for effectively influencing consumer purchasing decisions. With respect to foodservice operations, the primary means restaurants have to inform their customers is through the description of the meals they serve, either through information provision on menus or within restaurants (e.g., displays at a counter of a fast food outlet). More so than foodservice operators, food retailers have the ability to influence consumer purchasing decisions through many different sources of information provision, including working with food producers, manufacturers, and trade associations to find ways to better promote and display environmentally friendly products. In addition, food retailers can independently provide information about the environmental aspects of the products they sell through techniques such as providing point-of-purchase (POP) materials (e.g., signs, check-out lane displays, shelf-talker displays), which a recent study has illustrated to be effective (Reicks, et al., 1997).

POLICY IMPLICATIONS, OPPORTUNITIES, AND CONCLUSIONS

The primary environmental impacts of the foodservice and food retail industries identified in this paper point to a multitude of policy implications. Most importantly, the direct environmental impacts of the foodservice and food retail industries are not particularly significant in terms of their magnitude (with the important exception of food safety) and, thus, do not demand new or drastically modified legal or regulatory structures. In other words, this analysis does not indicate a regulatory failure or mismanagement of environmental problems, nor does it lead to the conclusion that a need exists for major new government intervention, either by the EPA or another agency, to address the environmental impacts of these two industries.

Moreover, since the problems themselves are generally not unique to the foodservice and food retail industries, their management will likely best be accomplished if targeted on a cross-industry basis, with perhaps industry-specific implementation strategies designed to ensure opportunities to maximize flexibility, efficiency, and innovation. Furthermore, the upstream and downstream environmental impacts of these industries, which represent significant opportunities for environmental gains, are more likely to be achieved through voluntary, incentive-based initiatives rather than through regulations promulgated by a government agency.

Though a regulatory response seems inappropriate, that does not mean that improved environmental performance by the foodservice and food retail industries should not and cannot be achieved. There exists a clear set of opportunities for these industries to reduce the direct environmental impacts of their operations and improve the overall environmental performance of the food marketing system. Significantly, many of the primary means for environmental advancements are directly controlled by individual foodservice and food retail companies, both in terms of mitigating restaurant or store-level impacts and through supply chain environmental management.

Ultimate conclusions regarding the policy implications and opportunities for improved environmental stewardship in these industries should be made contingent on further data collection and analysis and consideration of the unknown significance of cumulative effects. With respect to the lack of industry-wide data, few reporting requirements or monitoring systems presently are in place to collect data on the

environmental impacts of the foodservice and food retail industries. As a result of this dearth of industry-wide information, it is difficult to fully assess the environmental implications of these sectors. The EPA and other government agencies should work with these industries, and other service industries in which data are similarly lacking, to develop information collection systems so that a more precise assessment of the overall environmental effects of these industries can be conducted. Additionally, collaborative efforts between foodservice and food retail companies and organizations in the environmental community, such as the partnership formed in the early 1990s between McDonald's and the Environmental Defense Fund, can also facilitate efforts to better evaluate and address the environmental impacts of these industries.

A topic related to this lack of industry-wide data, and one that is relevant to most service industries, is the unknown cumulative impacts of multiple small actors. For instance, while air emissions from an individual restaurant may be minor, collectively restaurants may represent a significant source of important air pollutants. This “multiple small actors” phenomenon may be characteristic of foodservice and food retail industries in general, which adds further impetus to the need to amass data on an industry-wide basis. Though data limitations and uncertain cumulative impacts are constraints common to this type of industry-level research, they are particularly relevant in the study of service industries which have generally been a neglected area of analysis.

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This paper illustrates the importance of considering the environmental impacts of service sectors broadly, looking beyond the level of the service provision unit itself (retail outlet, office building) to include consideration of relationships with both suppliers and consumers. In this respect, the conceptual framework utilized in this analysis is a useful tool that can be applied to future research of service industries. While the relative importance of each of type of impact—direct, upstream, and downstream—may differ by industry, it is undoubtedly critical to evaluate each to capture the full magnitude of the environmental implications of service industries and to identify the levers for managing environmental impacts.

Environmental Implications of the Foodservice and Food Retail Industries

Terry Davies and David M. Konisky*

Introduction

The service sector represents an increasingly significant component of the U.S. economy. In 1950, service industries accounted for about 50% of Gross Domestic Product (GDP) and total employment (U.S. Census Bureau, 1951; U.S. Bureau of Economic Analysis, 1999). By 1997, service industries had grown to represent about 75% of GDP and total employment (U.S. Census Bureau, 1998; U.S. Bureau of Economic Analysis, 1998). Recent projections, furthermore, indicate that industries constituting the service sector will continue to grow relative to other segments of the national economy (Franklin, 1997). This trend is not limited to the United States, but is characteristic of many advanced economies, including those of Western Europe (Ellger and Scheiner, 1997). This shift to a service-based economy represents a dramatic change in the economic structure of the United States. Though the implications of this shift have been addressed with respect to issues such as productivity, labor and wages, and technological change (Guile and Quinn, 1988), it has yet to be sufficiently analyzed with respect to many other important issues, including its implications for environmental quality.

The current environmental management and regulatory system is focused primarily on the sectors of the economy that produce goods. Some analysts suggest that the shift to a service-based economy may necessitate changes in thinking about environmental policy and management (Allenby, 1997; Guile and Cohon, 1997; Rejeski, 1997; Graedel, 1998; Ellger and Scheiner, 1997; Grove, et al., 1996). However, exactly how (or whether) pollution control and natural resource management should be modified to best adapt to the growing importance of service-producing industries is difficult to determine until more is learned about the environmental impacts of service industries.

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The service sector, of course, is not a single entity. Rather, it encompasses a diverse set of industries, including finance, insurance, and real estate; wholesale and retail trade; transportation, communications, and utilities; business and legal services; government services; healthcare; foodservice; and tourism. The character and size of each of these service industries differ substantially, and, thus, to properly assess their environmental implications it is necessary to consider them individually. This paper takes this industry-specific approach and focuses on two particular service sector industries—foodservice (e.g., restaurants, school cafeterias) and food retail (e.g., grocery stores).

The foodservice and food retail industries are components of a larger industrial system that extends from the production of food to the marketing of food products to consumers. Though they are only part of this system, generally referred to as the food marketing system, these industries collectively represent the primary providers of food products to consumers. The foodservice and food retail industries themselves are quite different, but they both offer the same basic service of food provision and thus are covered together in this paper.

Using a simple conceptual framework, this paper has the objective to determine, and, to the extent possible, quantify the environmental impacts of the foodservice and food retail industries. Additionally, the paper aims to identify opportunities for environmental improvement within these industries. The paper argues that, while the direct environmental impacts (e.g., energy use, solid waste generation) of these industries are important to recognize, so too are the implications of their non-retailing activities, their relationships with other food industries, and their close linkages with their consumers.

Section 1 of the paper describes a conceptual framework for evaluating the environmental implications of service sectors and how it applies to the foodservice and food retail industries. Section 2 profiles the foodservice and food retail industries and highlights the major trends affecting their structure. Section 3 of the paper identifies and discusses the direct environmental impacts of foodservice and food retail operations, while sections 4 and 5 do the same for the upstream and downstream environmental implications, respectively. Lastly, Section 6 of the paper discusses policy implications,

enumerates a list of key opportunities for improved environmental performance, and offers some conclusions.

1. CONCEPTUAL FRAMEWORK

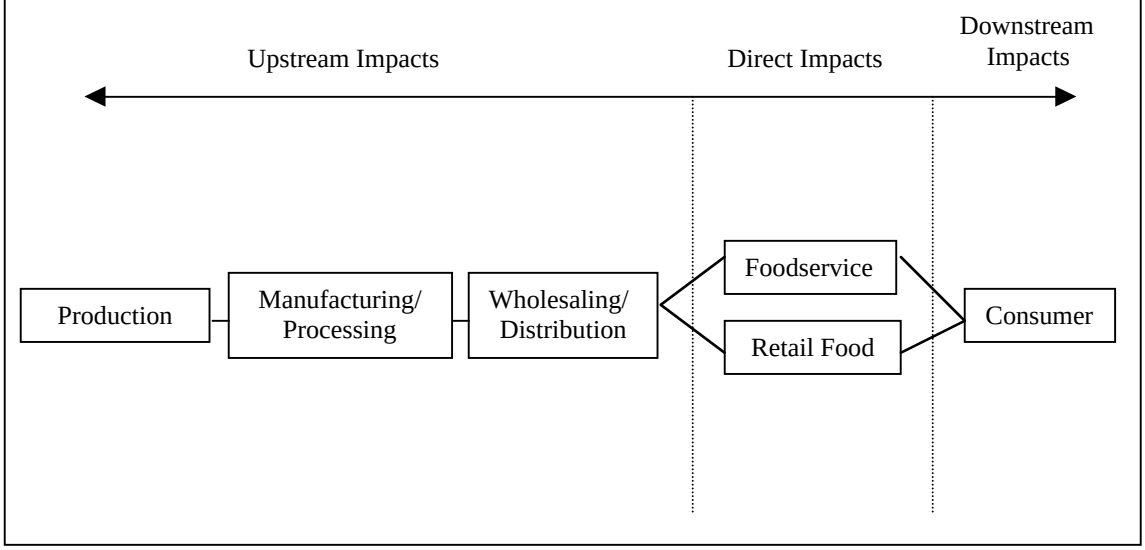
The current environmental protection system was established to regulate and manage the environmental impacts of goods-producing industries—manufacturing, mining, and agriculture—in which it was appropriate to concentrate on the environmental impacts of the inputs (e.g., materials, energy use) and outputs (e.g., air and water emissions, waste) of the specific production process. Service industries, however, fundamentally differ in their environmental reach. In addition to their direct environmental impacts, decisions that firms operating in service industries make with respect to their supply chain and their intimate connection to consumers also have important environmental implications that conventional analysis often overlooks.

This extended reach is particularly evident in the case of the foodservice and food retail industries because of their positions in the overall food marketing system. These industries, collectively constituting the retailing component of the food marketing system, represent the key link between food production, manufacturing, and distribution at one end, and consumers at the other. As described by Belonax (1999), “All that the U.S. food marketing system plans to accomplish is contained in the market offerings presented by the food retailers. Thus, as a consequence of their position, they carry the entire burden of the U.S. food marketing system.”

In this position, moreover, foodservice and food retail companies can significantly influence the environmental behavior of both their suppliers and consumers. For example, if a national chain of restaurants decides to use only organically grown fruits and vegetables in its meals, the impact may be considerable with respect to the processors and wholesalers with which it contracts. The decision may, in turn, send signals to producers that they should consider cultivating crops without synthetic fertilizers or pesticides. Similarly, with respect to consumer behavior, if a national chain of supermarkets implements a bottle-return system in which consumers are rewarded for bringing used glass bottles back to the store for recycling, this may raise consumer awareness to the opportunities to reduce their contributions to the solid waste stream.

Thus, to appropriately account for the full environmental magnitude—positive and negative—of foodservice and food retail industries, it is necessary to look beyond the boundaries of the restaurant or grocery store to include the potential environmental gains that can be harnessed through the relationships of these service industries with their suppliers and consumers. Determining these environmental impacts is complicated by a lack of suitable metrics and approaches for measuring the environmental responsibility of a service industry (Graedel, 1998). A conceptual framework has begun to emerge in the literature, however, which provides a useful and pragmatic approach to understanding the environmental impacts of service industries. This approach segregates the environmental impacts of services into three basic categories: direct, upstream, and downstream (Guile and Cohon, 1997; Rejeski, 1997). Figure 1.1 shows the application of this conceptual framework to the foodservice and food retail industries.

FIGURE 1.1. CONCEPTUAL FRAMEWORK OF THE ENVIRONMENTAL IMPLICATIONS OF THE FOODSERVICE AND FOOD RETAIL INDUSTRIES



The direct environmental impacts of service industries refer to the effects of the service provision itself. Such impacts include energy use, water pollution, and additions to the solid waste stream. In this respect, the environmental impacts are similar to those of goods-producing industries, and relate to the resources used or byproducts created by generating the service.

Upstream environmental impacts refer primarily to the influence service companies have over their supply chains. Service providers can exert extraordinary power through their economic clout to influence the environmental behavior of suppliers, especially in cases where the service company is larger than the supplier. Sometimes referred to as "greening the supply chain" (Green, et al., 1996), companies can alter suppliers' environmental performance through their purchasing decisions. McDonald's, for instance, requires 2 million pounds of potatoes daily to serve its daily clientele of 20-30 million people. Due to the magnitude of this demand, McDonald's and other firms in similar circumstances can create an environmental market where none exists. They are also in a position to pass customer signals concerning environmental preferences back to manufacturers (Rejeski, 1997). As conceptualized in this analysis, upstream environmental impacts also include the activities of foodservice and food retail companies occurring at other stages of the food marketing system. This is particularly relevant due to the number of these companies that have achieved high levels of vertical coordination. As pointed out by Rejeski (1997), in many cases service companies themselves are not yet fully aware of the power they can wield over environmental decisions in the manufacturing and agricultural sectors.

The last category of environmental impacts are those that occur downstream, relating to the linkages between service companies and consumer behavior. More so than goods-producing industries, service companies are closely connected with their customers. Through a combination of direct consumer contact and the scale of their operations, service companies play an important role in consumer education about the environment. More significantly, the service sector has early insights into consumer preferences and buying habits, environmental or otherwise, which can be passed back to the goods-producing sectors of the economy (Guile and Cohon, 1997; Rejeski, 1997).

An example will illustrate why this framework is useful for structuring an analysis of the environmental impacts of the foodservice and food retail industries. Consider the energy usage associated with a can of sweet corn (455 grams), a product found at a typical supermarket. The supermarket itself consumes some energy for the distribution and retailing of the product, but energy use is more intensive at the other stages of the food marketing system. The processing and packaging of the sweet corn alone accounts

for about 43% of the total energy used (Pimentel and Pimentel, 1996). Through its potential upstream leverage, the supermarket may be able to encourage the supplier of the corn to use less energy, either through improvements in the energy efficiency of processing or through the use of a different type of packaging. Thus, the potential environmental reach of the supermarket extends beyond that of its own operations, and can be harnessed to achieve environmental improvements at all stages of the food marketing system.

2. OVERVIEW OF THE FOODSERVICE AND FOOD RETAIL INDUSTRIES

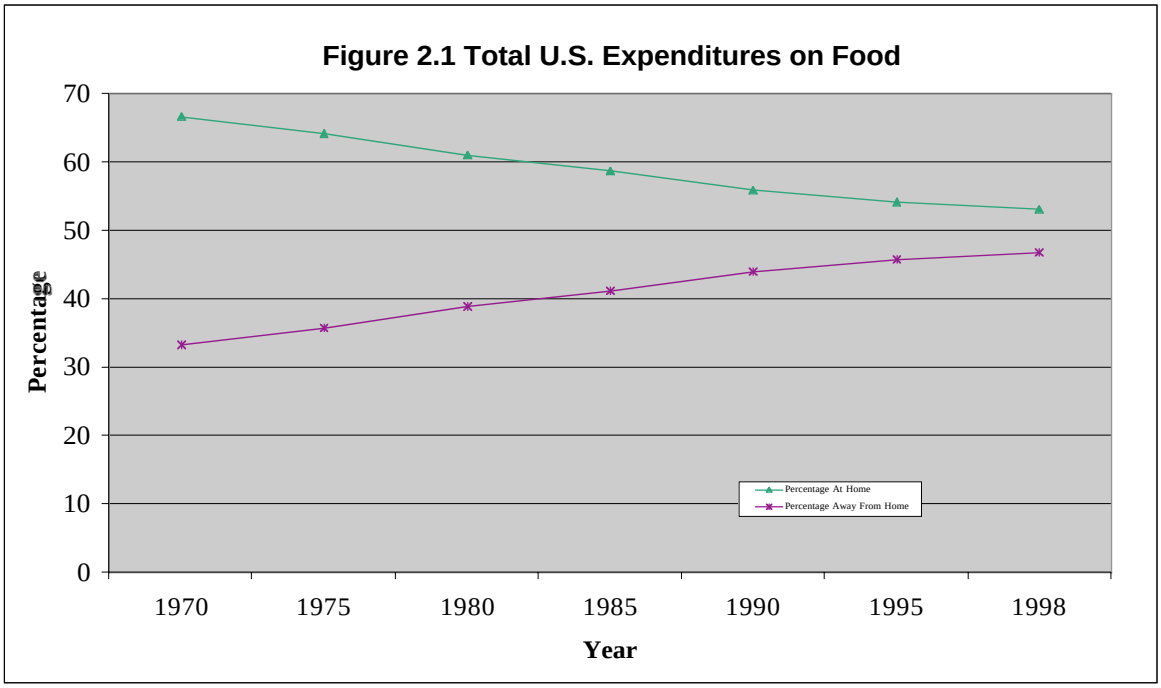
Prior to identifying and discussing the environmental impacts of the foodservice and food retail industries, it is useful to describe each industry. This is particularly important due to the changes occurring within each industry, many of which are integral to understanding the respective environmental implications of foodservice and food retail operations. A brief profile of each industry is provided below.

Foodservice Industry

The foodservice industry consists of all operations that sell prepared foods, snacks, and beverages for on-premise or immediate off-premise consumption (Marion, 1986). There are an estimated 831,000 individual foodservice establishments in the United States, with total sales in the industry expected to reach $376 billion in 2000. The foodservice industry is among the largest employers in the nation, with an estimated 11 million people (about 8.6% of the U.S. workforce) currently working in foodservice establishments (NRA, 2000).

Expenditures on food from foodservice facilities have been steadily increasing for most of the century. An increasing amount of the consumer food dollar is being spent on food purchased for consumption away from home. Figure 2.1 shows the changes since 1970, though the faster growth in the foodservice market relative to the food retail market has been prevalent since the Great Depression (Manchester, 1992). Due primarily to rising incomes and changes in lifestyles, the shift in locale of food consumption from food at home to food away from home is one of the most significant changes in the overall food marketing system, with foodservice sales forecasted to continue to rise as a proportion of overall food expenditures (Manchester, 1992; Standard & Poor's, 1999).

Foodservice facilities are generally classified into two market segments: commercial and noncommercial. Commercial foodservice facilities include separate eating and drinking places whose main activity is to provide food and beverages (e.g., fast food outlets). Noncommercial foodservice facilities,[1] in contrast, are operations that



Source: USDA/ERS (1999b).

are run primarily as subsidiaries or complements to other business and service activities (e.g., cafeterias in correctional facilities) (Kroll, 1992). Total sales from commercial foodservice sources far exceed those of noncommercial foodservice. According to the USDA's Economic Research Service (1998), sales from commercial and noncommercial outlets in 1997 were approximately $229 billion (79%) and $61 billion (21%), respectively.[2] Moreover, commercial foodservice sales have been growing at a faster pace over the past couple of decades compared with those of noncommercial foodservice, as is illustrated in Table 2.1.

[1] The noncommercial segment is sometimes subdivided into two components: (1) noncommercial—foodservice provided at business and industry sites (e.g. transportation/in-transit service, leisure, recreation, and sports sites.); and (2) institutional—foodservice provided at educational, healthcare, military, and prison facilities. See Kroll (1992).

[2] Noncommercial food sales represent a combination of sales and, for those noncommercial foodservice operations that do not "sell" food (e.g., correctional facilities), foodservice-related expenditures. (Jekanowski, 1999).

TABLE 2.1. FOODSERVICE SALES, BY MARKET SEGMENT

	Commercial		*Noncommercial*		*Total*
Year	*Million Dollars*	*Percent*	*Million Dollars*	*Percent*	*(Million Dollars)*
1977	56,264	69	25,151	31	81,415
1987	141,600	76	42,200	24	185,800
1997	229,375	79	60,851	21	290,226

Sources: Marion (1986); Connor and Schiek (1997); and USDA/ERS (1998).

The commercial foodservice sector is generally subdivided into the following segments: restaurants and lunchrooms, fast food outlets, cafeterias, social caterers, lodging places, retail hosts, recreation and entertainment, and separate drinking places. Table 2.2 shows the relative size of each in terms of total sales over the past two decades. The largest industry segments are fast food outlets and restaurants and lunchrooms, accounting in 1997 for $96.8 billion (42%) and $83.1 billion (36%), respectively (USDA/ERS, 1998).

Since the end of World War II, the commercial foodservice market segment has undergone considerable changes, the most significant of which has been the increasing size of the fast food segment. Fast food outlets, often referred to as quick service restaurants, emerged in the late 1940s, rapidly developed and expanded over the next few decades (in large measure due to the success of franchising), and became the dominant consumer eating choice in the 1980s and 1990s (Nagengast and Appleton, 1994). Fast food restaurants are responsible for a large amount of the growth in away from home food consumption (Manchester, 1992), with total sales in 1999 expected to top $110.4 billion (NRA, 1999). As evidence of the importance of fast food restaurants in the commercial foodservice industry, Table 2.3 illustrates that about half of the top 25 foodservice chains, ranked in terms of total domestic sales in 1998, were fast food operations.

TABLE 2.2. COMMERCIAL FOODSERVICE SALES, BY INDUSTRY SEGMENT

Industry Segment	*1977*	*1987*	*1997*
		Billion Dollars	
Fast Food Outlets	24.7	57.9	96.8
Restaurants and Lunchrooms	20.3	58.6	83.1
Retail Hosts	2.7	5.9	16.7
Lodging Places	3.6	9.3	14.5
Recreation and Entertainment	1.9	4.3	10.5
Cafeterias	1.8	3.1	4.2
Separate Drinking Places	1.0	1.5	1.8
Social Caterers	-	0.9	1.8
Total	56	141.5	229.4

Source: USDA/ERS (1998).

The increasing dominance of the fast food segment of the commercial foodservice industry has had important implications for farm products and markets. Fueled by growing consumer demand, the fast food industry has participated in and driven the consolidation of markets, the expansion of grower-manufacturer partnerships, the increasing dependency on technology, the increasing size of farms, and the increasing specialization of products to satisfy the demand for nutritious, safe, different, and cheap food (Nagengast and Appleton, 1994). The fast food industry's contribution to these changes also evidences the type of large upstream influence that companies can have on other stages of the food marketing system. McDonald's, for instance, is the largest consumer of beef in the United States and uses 7.5% of the nation's potato crop (Senauer, et al., 1991; Kohls and Uhl, 1990). Due to its sizeable demand, the decisions that McDonald's makes with respect to suppliers and purchasing have considerable implications for the entire market.

As was mentioned above, the noncommercial foodservice industry is considerably smaller than the commercial market segment, both in terms of total sales and number of establishments. Noncommercial foodservice consists of numerous industry segments including operations at healthcare, educational, military, and correctional facilities, in plants and office buildings, at associations, within transportation operations, and vending.

TABLE 2.3. TOP 25 CHAIN RESTAURANTS, BY U.S. SALES, 1998

Rank	*Company*	*Number of Units*	*Dollars (in millions)*
1	McDonald's	12,472	18,123.0
2	Burger King	7,946	8,245.0
3	Taco Bell	6,880	5,000.0
4	Wendy's	4,676	4,994.2
5	Pizza Hut	8,471	4,800.0
6	KFC	5,132	4,200.0
7	Aramark Global Food/Leisure Services	2,415	3,437.0
8	Subway	11,540	3,100.0
9	Hardee's	2,713	2,394.0
10	Domino's Pizza	4,489	2,300.0
11	Arby's	2,965	2,077.0
12	Applebee's Neighborhood Bar & Grill	1,046	2,032.0
13	Dairy Queen	5,091	2,015.0
14	Denny's	1,656	1,963.0
15	Dunkin' Donuts	3,537	1,960.0
16	Red Lobster	635	1,932.0
17	Olive Garden	459	1,490.0
18	Jack in the Box	1,555	1,452.0
19	Outback Steakhouse	517	1,447.0
20	Marriott Hotels, Resorts, and Suites	485	1,390.0
21	Chili's Grill & Bar	586	1,375.0
22	Sonic Drive-In	1,847	1,337.0
23	Little Caesars Pizza	4,350	1,250.0
24	LSG Lufthansa Services/Sky Chef	75	1,220.0
25	Papa John's Pizza	1,879	1,156.3

Source: Nation's Restaurant News (1999).

As is illustrated in Table 2.4, within the noncommercial foodservice industry, educational facilities constitute the largest individual segment, both in terms of sales and number of individual operations (McCool, et al., 1994).

Individual companies sometimes specialize in a particular noncommercial industry segment while others operate in numerous industry segments. As a general rule, the largest companies operate at the national scale and are active in several industry segments. For instance, Canteen, based in Chicago and owned by the Aramark Corporation, operates in many types of industry segments including educational institutions, healthcare facilities, plants and office buildings, and prisons. In contrast, smaller companies tend to specialize in a specific geographical area and/or in a single industry segment. For example, Culinary Service Network, based in Blue Bell, Pennsylvania, only operates in retirement communities (McCool, et al., 1994).

TABLE 2.4. NONCOMMERCIAL FOODSERVICE SALES, BY INDUSTRY SEGMENT

Industry Segment	***1977***	***1987***	***1997***
		Billion Dollars	
Education	8.2	16.6	23.1
Healthcare Facilities[†]	6.1	8.7	11.8
Plants and Office Buildings	3.6	4.3	6.5
Vending	2.5	5.3	5.9
Transportation	1.1	3.7	4.6
Correctional facilities	-	1.7	3.1
Military Services	1.1	1.4	1.9
Associations	-	1.4	1.8
Other	2.1	1.1	2.3
Total	24.7	44.2	60.9

[†]Includes extended care facilities, child day care, and elderly feeding programs.
Source: USDA/ERS (1998).

A major trend in noncommercial foodservice is the growth of contract foodservice management. Professional foodservice management companies represent an increasing market share of the noncommercial foodservice industry as host organizations of all types are transferring management of their foodservice operations to companies specializing in noncommercial operations (Warner, 1994). Two of the largest 25 chain foodservice companies (Aramark Global Food/Leisure Services and LSG Lufthansa Services Sky Chef) and nine of the largest 50 chain foodservice companies concentrate on contract foodservice management. Furthermore, in terms of U.S. revenues, three of the six largest foodservice companies earn most of their revenues as contract operators in the noncommercial market segment: Sodexho Marriott Services ($3.5 billion), Aramark Corporation ($3.4 billion), and Compass Group PLC ($2.3 billion) (Nation's Restaurant News, 1999).

Another significant trend changing this segment of the foodservice industry is what has been termed the commercialization of noncommercial foodservices. This trend, in part, refers to the shift of noncommercial food operations from institutional-like foodservice to those that resemble restaurant-like foodservice. For example, Aramark converted a café it operates for Goldman Sachs in New York City from a standard, cafeteria-style establishment to one representative of a market-style eatery with individual food stations (Matsumoto, 1999). Noncommercial foodservice operators

increasingly are offering branded products and concepts, using sophisticated merchandising techniques, and considering more thoroughly the foodservice price-value relationship for the clientele (McCool, et al, 1994; Matsumoto, 1999).

Market concentration is increasing in the commercial and noncommercial foodservice industry. Concentration in the foodservice industry almost doubled between 1972 and 1992, due largely to the growing dominance of national restaurant chains and large foodservice management companies. Though less prevalent than in other food marketing industries, the trend toward increased concentration will likely persist as franchise and chain growth continues (Connor and Schiek, 1997).

Food Retail Industry

The food retail industry comprises two primary categories: grocery stores and specialized food stores. Grocery stores are commonly defined as any retail establishment selling a line of dry grocery, canned goods or nonfood items, plus some perishables (Progressive Grocer, 1997a). The modern grocery store, of course, often offers more than simply a selection of finished food products, including a mix of prepared foods (e.g., deli, bakery) and services (e.g., pharmacy, florist, bank). Specialty food stores, in contrast, typically concentrate on a particular type of food and include establishments such as bakeries, seafood stores, and gourmet food shops (Connor and Schiek, 1997). (Unless otherwise noted, this paper limits its focus to the grocery store segment, due to its predominant role in the food retail industry.) In 1998, there were 126,000 grocery stores in the United States, employing 3.5 million people (about 2.7% of the U.S. workforce) (FMI, 1999). Total sales from grocery stores constitute the largest of any other industry in the food marketing system, totaling $449 billion in 1998 (Progressive Grocer, 1999), exceeding foodservice by about 27%.

As was illustrated in Figure 2.1, expenditures from food stores in terms of the share of the consumer dollar spent on food have been declining. However, they still accounted for over 53% of total food expenditures in 1998 (USDA/ERS, 1999b), and moreover, consumers are increasingly turning to grocery stores for take-out foods (Dulen and Lowe, 1997), known as "home meal replacements" or "meal solutions." The Food Marketing Institute (1999) found that 83.6% of supermarket retailers offered prepared foods in 1998. The Food Marketing Institute (1998b) also found that, in 1997, while

consumers bought most of their take-out foods from fast food restaurants (37%), 20% of take-out foods were purchased at supermarkets, an increase from 12% the year before and the equivalent amount bought from traditional restaurants.

The major type of grocery store is the supermarket. As is shown in Table 2.5, there are 30,700 supermarkets across the United States, accounting for $346.1 billion in total sales in 1998, or 77.0% of total grocery industry sales. About 64% of these supermarkets are operated by corporate chains (11 or more stores) with most of the remainder participating as members of cooperative or voluntary groups. Convenience and other stores constitute a much greater number of establishments, but collectively account for less than a quarter of grocery industry sales (Progressive Grocer, 1999; Marion, 1998).

TABLE 2.5. FOOD RETAIL INDUSTRY SALES, BY STORE TYPE, 1998

Store Type	***Number of Stores***	***% of Total***	***Sales (billion dollars)***	***% of Total***
All Grocery Stores	126,000	100.0	449.0	100.0
Supermarkets	30,700	24.4	346.1	77.0
Chain	*(19,530)*	*(15.5)*	*(274.5)*	*(61.1)*
Independent	*(11,170)*	*(8.9)*	*(71.6)*	*(15.9)*
Convenience Stores	57,000	45.2	28.0*	6.3
Other Stores[†]	38,300	30.4	74.9	16.7

*Supermarket items only.
[†]Includes wholesale clubs with at least 50% of total sales in grocery items.
Source: Adapted from Progressive Grocer (1999).

Several trends are dramatically reshaping the food retail industry. One is the emergence of alternative supermarket formats, as is illustrated in Table 2.6. In 1980, conventional supermarkets were the dominant format in the industry, accounting for 85.0% of the total stores and 73.1% of the total sales. In 1997, the conventional format accounted for 43.8% of the total number of supermarkets, but only 18.5% of the sales (Kaufman, 1998a). Filling this gap were a number of alternative supermarket formats, especially superstores, combination stores, and warehouse stores. The growth in alternative formats represents a recognition by the grocery industry that one format no longer satisfies all customers (Connor and Schiek, 1997).

TABLE 2.6. SUPERMARKET FORMATS, BY NUMBER AND SHARE OF SALES

	Number		Share of Sales	
	1980	*1997*	*1980*	*1997*
Supermarket Format	Percent			
Conventional	85.0	43.8	73.1	18.5
Superstore	8.9	30.8	17.7	43.2
Combination	0.9	12.0	4.0	21.0
Warehouse/Limited Assortment	4.7	9.5	4.2	7.2
Superwarehouse	0.5	2.1	1.0	3.9
Hypermarket	-	1.0	-	5.4
Natural Foods	-	0.7	-	0.7

Source: Kaufman (1998a); Progressive Grocer (1997a); Connor and Schiek (1997).
Conventional Supermarket—A full-line, self-service grocery store with annual sales of $2.5 million or more (1985 dollars).
Superstore—A supermarket with at least 30,000 square feet, doing $12 million of business or more annually and offering an expanded selection of nonfood items. Offers specialty departments and extensive services.
Combination Store—Same as a superstore, but the space devoted to nonfood items is 40% or more. Evolved from combination food and drug stores through common checkout.
Warehouse Store—A store with more than 1,500 items, primarily dry grocery, with some perishables. Small gross margin and workforce. Limited service. Most have scanner checkouts. A hybrid warehouse store has the same characteristics, but includes more than 7,500 items, mostly perishables, and possibly some specialized service departments, such as a deli. Warehouse stores tend to eliminate frills and concentrate on price appeal.
Limited Assortment—A store with fewer than 1,500 items, primarily dry grocery, with few, if any, perishables. Small gross margin and workforce with virtually no service.
Superwarehouse Store—Same as warehouse store, but offers more product variety and services than the typical warehouse store.
Hypermarket—A large store with general merchandise sales accounting for as much as 40% of total store sales.
Natural Foods—A supermarket with the majority of sales in foods minimally processed and free of artificial ingredients, preservatives, and other non-naturally occurring chemicals. Natural foods stores are not normally classified separately from conventional supermarkets.

In addition to the emergence of alternative supermarket formats, there also has been an increase in competition in food sales from nontraditional retailers. The nontraditional segment is the fastest expanding source of food retail sales. In 1997, food sales from nontraditional retailers totaled $64.9 billion, a 72% increase from 1992 (Kaufman 1998b). The two most notable types of nontraditional retailers are supercenters and wholesale clubs. Supercenters, also known as discount department stores or mass merchandisers, are large food/drug combination stores and mass merchandisers within a single establishment. These retail establishments average more than 150,000 square feet and typically devote as much as 40% of their space to grocery items (Progressive Grocer, 1997a). Supercenters accounted for about 7% of food retail sales in 1997, an increase

from about 2.5% in 1992 (Kaufman, 1998b). The major supercenter operators are Wal-Mart, K-mart, Target (collectively accounting for approximately 70% of total sales from supercenters), Meijer, and Fred Meyer (Larson, 1997; Capps, 1997).

Wholesale clubs are the other primary type of nontraditional retailer. A wholesale club is a membership retail/wholesale hybrid with a varied selection and limited variety of products presented in a warehouse-type atmosphere. These establishments generally measure 90,000-plus square feet, carry 60 to 70% general merchandise and health and beauty care products, with the remaining stock in a grocery line dedicated to large sizes and bulk sales (Progressive Grocer, 1997a). Wholesale clubs accounted for more than 2% of food retail sales in 1997 (Kaufman, 1998b). The major operators of wholesale clubs are Costco and Sam's.

Another important trend affecting the structure of the food retail industry is the recent wave of consolidation. In 1998, there were at least 35 significant mergers. Consolidation has generally not been driven by financial interests, but rather by a set of strategic factors (Progressive Grocer, 1999). For one, as opportunities for growth have narrowed in an increasingly competitive environment, food retailers have acquired existing units or entire chains as a means of expansion. Second, retail companies often find it less costly to grow through acquisitions than to build from scratch, and, moreover, are better able to generate economies of scale in marketing and advertising, procurement, distribution, technology, corporate overhead, and private-label (store brand) development (Standard & Poor's, 1998). In 1998 alone, a number of high-profile mergers and acquisitions dramatically changed the food retail industry, highlighted by Kroger's acquisition of Fred Meyer, Inc. (the most expensive deal in industry history at $12.8 billion) and Albertson's Inc.'s purchase of American Stores (at $11.7 billion) (Progressive Grocer, 1999). In terms of 1998 sales, as is illustrated in Table 2.7, these companies were already among the largest food retailers in the United States.

Closely related to the rise in consolidation, the increased level of market concentration is another key development affecting the food retail industry. The four largest companies in the food retail industry (Kroger, Co., Safeway Inc., Ahold USA, Inc., and Albertson's Inc.) account for an estimated one-third of all U.S. sales (Progressive Grocer, 1999). Though consolidation has resulted in growing concentration

TABLE 2.7. TOP 25 U.S. FOOD RETAILERS, 1998 SALES

Rank	*Company*	*Number of Stores*	*Dollars (in millions)*
1	The Kroger Co.	2,207	28,203.3
2	Safeway Inc.	1,493	24,484.2
3	Ahold USA, Inc.	880	16,200.0
4	Albertson's, Inc.	985	16,005.1
5	Costco Companies, Inc.	280	15,251.4
6	Fred Meyer, Inc.	853	14,025.0
7	American Stores Company	807	13,755.8
8	Winn-Dixie Stores, Inc.	1,180	13,617.5
9	Wal-Mart Supercenters	564	12,800.0
10	Publix Super Markets, Inc.	586	12,100.0
11	Food Lion, Inc.	1207	10,219.5
12	Great Atlantic & Pacific Tea Co.	913	10,179.4
13	Sam's Club	451	8,267.2
14	H.E. Butt Grocery Co.	258	7,000.0
15	The Stop and Shop Supermarket Co.	190	5,500.0
16	Super Valu, Inc.	330	4,984.0
17	Giant Food, Inc.	173	4,400.0
18	Meijer, Inc.	117	4,063.5
19	Pathmark Stores, Inc.	133	3,771.0
20	Giant Food Stores, Inc.	164	3,700.0
21	Fleming Companies Inc.	381	3,557.5
22	Hannaford Bros., Co.	150	3,323.6
23	Top's Markets, Inc.	240	3,238.4
24	Hy-Vee, Inc.	221	2,945.8
25	Bi-Lo, Inc.	253	2,900.0

Does not reflect recent mergers and acquisitions.
Source: Chain Store Guide Information Services (1999).

on the national level, market share dominance is more pronounced on the local level (Moody, 1997). Concentration, as measured as a percent of local market sales shared by the four largest grocery store chains in metropolitan statistical areas (MSAs), was found in 1987 to be about 77% (Kinsey, 1998; Franklin and Cotterill, 1993).

A final important trend impacting the food retail industry is the emergence of private label products. Private label products presently account for about 5 to 10% of the items and for about 15 to 20% of the sales from the typical supermarket (Connor and Schiek, 1997; Marion, 1998). As an alternative to generic products, which have generally failed to bring higher store profit margins, supermarket retailers have increasingly turned to private label products. Excluding self-manufacturing, food retail operators have adopted one of three basic strategies: contracting with food processors to provide food products with the store's own name (store brands), purchasing brands owned by grocery

wholesalers (controlled brands), or contracting for a brand that is unique to the grocery chain in a given market (private brands). Food retailers have turned to private label products as a means to vie with competitors and improve store profits (Connor and Schiek, 1997). Both chain and independent grocery retailers indicated in a recent survey that private label products would continue to be an important part of their operations (Progressive Grocer, 1999).

3. DIRECT ENVIRONMENTAL IMPACTS

Determining the precise environmental impacts of the foodservice and food retail industry is complicated by limited and sporadic data. Undoubtedly, many companies in these sectors have made considerable efforts to improve their environmental performance, often realizing financial gain for doing so (e.g., lower utility bills from energy efficiency investments, lower solid waste disposal expenses from recycling efforts), while others have lagged behind. Survey data provide some insight into the environmental practices of these industries,[3] but there is a dearth of basic information at the industry level with respect to the aggregate environmental impacts of foodservice and food retail operations. Moreover, there seems to be a relative lack of concern, at least in the food retail industry, that environmental issues are a significant problem confronting the industry.[4]

Many of the direct environmental impacts of foodservice and food retail operations are not unique to these service industries. Issues such as energy consumption and solid waste generation may differ in their specific nature, but the impacts themselves are not wholly different from those occurring in other industries. Some of the direct environmental impacts discussed below, however, are unique to, or at least particularly prevalent in, foodservice and food retail operations, including food waste, food safety, and CFC-containing refrigerants.

[3] For example, the Food Marketing Institute (1997d) conducted a survey in 1997 to evaluate the environmental practices of supermarkets.

[4] According to a recent Progressive Grocer (1999) survey of supermarket executives, environmental issues were ranked last on a list of 14 issues confronting the food retail industry.

Energy Consumption

Total energy use in commercial foodservice and food retail operations accounts for less than 1% of total domestic energy consumption (DOE/EIA, 1999; DOE/EIA, 1998).[5] In terms of the commercial foodservice industry, in 1995, energy consumption totaled 332 trillion Btu (British thermal units), accounting for approximately 6.2% of total commercial building energy consumption. Table 3.1 breaks down commercial foodservice energy consumption by end use. Energy used for cooking accounts for the most, a third of the total, followed in order by that consumed for lighting, refrigeration, space heating, water heating, cooling, ventilation, and office equipment. In terms of total expenditures, the foodservice industry spent over $4.8 billion on major fuels (electricity, natural gas, fuel oil, and district heat) in 1995, costing an average of 4.5% of total sales for restaurants (DOE/EIA, 1998; Bertagnoli, 1996).

TABLE 3.1. MAJOR FUEL CONSUMPTION OF FOODSERVICE INDUSTRY, BY END USE, 1995

End Use	*Trillion Btu*	***Percent of Total***
Cooking	105	31.6
Lighting	50	15.1
Refrigeration	43	13.0
Space Heating	42	12.6
Water Heating	37	11.1
Cooling	26	7.8
Ventilation	7	2.1
Office Equipment	3	0.9
Other	18	5.4
Total	331*	99.6*

*Discrepancy due to rounding.
Source: DOE/EIA (1998).

The above data do not include energy use from noncommercial foodservice sources. Unfortunately, little analysis of energy consumption in noncommercial foodservice operations has occurred, likely in part because data are collected only as an aggregate of the overall business or service activity. For example, while data exist for the total energy consumed by healthcare facilities, specific energy use information for the foodservice facilities operating within them is generally not available. The absence of specific data is revealing, as it points to an energy management dilemma that often

emerges in noncommercial foodservice operations. Managers have little incentive to place a high priority on energy management, since energy costs are allocated on a prorated basis among various departments based on such parameters as square footage, traffic patterns, and the number of laborers. Thus, if energy expenses are included in general overhead costs, little accountability exists for the actual amount of energy used (Kobliner, 1994).

The one noncommercial foodservice industry segment that has been studied is educational facilities. Kobliner (1994) studied four school systems in Oregon, each with a different type of foodservice operation, and found that the total mean energy consumption to produce one school foodservice meal was 2,590 ±1,333 Btu. More specifically, Kobliner's analysis showed that the four systems—cook/chill-satellite, conventional-on-site, cook/chill-on-site, and conventional-satellite[6]—varied significantly in their energy use. The cook/chill-satellite system was found to be most energy-efficient, with a mean energy consumption per meal of 1,016 Btu, followed in order by the conventional-satellite system (2,037 Btu), the cook/chill-on-site system (3,622 Btu), and the conventional-on-site system (3,683 Btu) (Kobliner, 1994).

With respect to energy use in the food retail industry, consumption totaled 137 trillion Btu in 1995, accounting for approximately 2.6% of total commercial building energy consumption (DOE/EIA, 1998). Table 3.2 illustrates food retail energy consumption by end use, and shows that fuel use for refrigeration accounts for over half of the total. Other major uses of energy include lighting and space heating.

Though the foodservice and food retail industries are responsible for only a small proportion of overall U.S. energy consumption, individual operations in both industries are quite energy-intensive. Foodservice and food retail buildings, in fact, are two of only three types of principal building activities that have significantly higher energy intensity than is average for all commercial buildings (the other is healthcare facilities). Foodservice establishments are the most intensive energy users in the commercial sector (DOE/EIA, 1998; Energy Conservation News, 1997). The average foodservice operation

[5] This number excludes energy consumption in noncommercial foodservice operations.
[6] In the cook/chill production system, meals are cooked to inventory, then chilled and stored (either at a satellite location or on-site) for future service. In the conventional production system, meals are produced

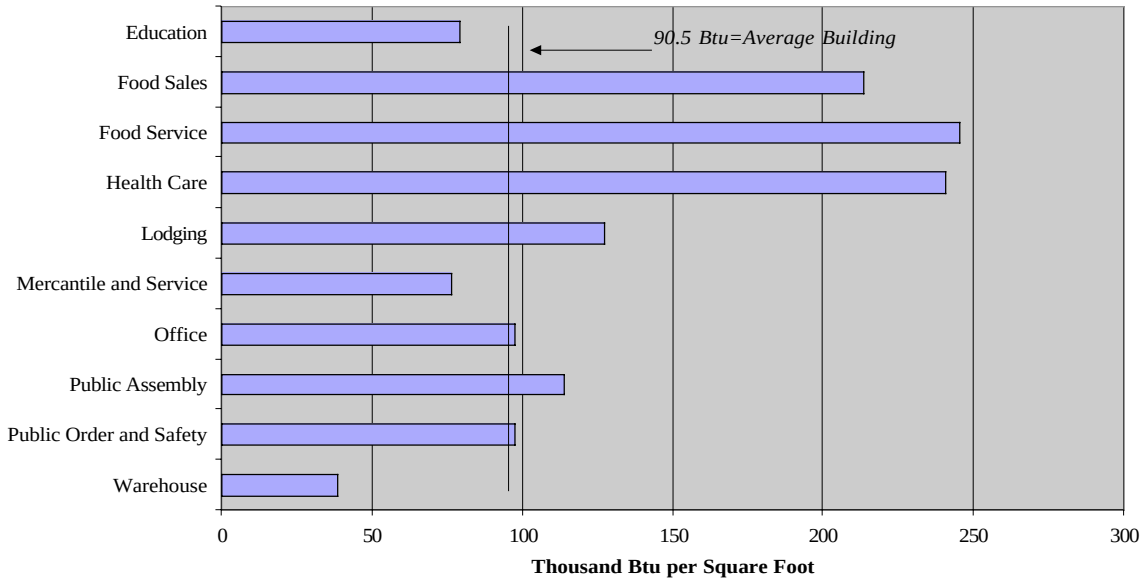
TABLE 3.2. MAJOR FUEL CONSUMPTION OF FOOD RETAIL INDUSTRY, BY END USE, 1995

End Use	*Trillion Btu*	***Percent of Total***
Refrigeration	71	51.8
Lighting	22	16.1
Space Heating	18	13.1
Cooling	9	6.6
Water Heating	6	4.4
Cooking	4	2.9
Ventilation	3	2.2
Office Equipment	1	0.7
Other	5	3.6
Total	137*	101.4*

*Discrepancy due to rounding.
Source: DOE/EIA (1998).

uses 245.4 thousand Btu per square foot, whereas the average commercial building uses 90.5 thousand Btu per square foot (DOE/EIA, 1998). Figure 3.1 compares the energy intensity of foodservice with other principal building activities.

Figure 3.1 Energy Intensity by Principal Building Activity



Source: DOE/EIA (1998).

from market forms of food in various stages of production and served shortly thereafter. See Kobliner (1994).

Foodservice operations are especially energy-intensive with respect to their use of electricity and natural gas. In terms of electricity, the average foodservice building used 122.8 thousand Btu per square foot in 1995, compared with an average of 45.7 for other commercial buildings. Over half of this electricity was used for lighting and refrigeration. With respect to natural gas, the average foodservice building consumed 157.7 thousand Btu per square foot, compared with an average of only 51.0 for other commercial buildings. Approximately 60% of this natural gas consumption was for cooking (DOE/EIA, 1998).

Similar to foodservice establishments, food retail buildings also have significantly higher energy intensity than the average commercial building; in 1995, the average food retail outlet used 213.4 thousand Btu per square foot. Food retail outlets were especially energy-intensive with respect to their use of electricity, representing the most electricity intensive principal building type. The average food retail building used 184.7 thousand Btu per square foot, more than four times the average of other commercial buildings. Over 60% of this electricity was used for refrigeration (DOE/EIA, 1998).

Results from a 1997 Food Marketing Institute survey of 108 companies (representing 5,810 stores) indicate a mixed performance of food retail operations with respect to energy issues. While most respondents answered that most of the time they use energy-efficient lighting and investigate opportunities to reduce energy usage, most said that they do not systematically collect data on energy usage. The average retail operation, moreover, indicated that it only placed moderate emphasis on ensuring in-house expertise on energy issues such as efficiency, conservation practices, and humidity control (FMI, 1997d).

It is difficult to generalize on an industry-wide scale about energy use. There is likely a broad range of performance among companies and individual establishments operating in the foodservice and food retail industries. Some companies have made significant investments in energy efficiency, such as improved lighting and facility design (and realized utility savings at the same time), while others have not. In general, though, the energy intensity of these service operations suggests that substantial opportunities remain to reduce energy usage in these industries, thereby simultaneously lessening its associated environmental impacts.

Solid Waste Generation

Numerous solid waste characterization studies have been conducted for foodservice and food retail operations. These studies typically divide solid waste into two categories: food waste (e.g., plate waste, production waste) and packaging materials (e.g., service materials, corrugated boxes, glass, plastic). With respect to the foodservice industry, numerous waste stream analyses have been conducted for both commercial and noncommercial operations.[7] As is evident in Table 3.3, many studies have shown that when measured in terms of weight, food waste constitutes the largest component of the foodservice waste stream, whereas, when measured in terms of volume, packaging becomes the major waste stream generated by foodservice operations.

TABLE 3.3. SOLID WASTE STREAM ANALYSIS FOR SELECTED FOODSERVICE OPERATIONS

	Commercial		*Noncommercial*				
	2 McDonald's Restaurants[1]	**2 hotel food and beverage operations[2]**	**Military[3]**	**University[4]**		**School Foodservice (6 schools)[5]**	**Extended Care Facility[6]**
				Conventional	**Convenience**		
	Percent of Operation's Waste Stream						
Weight							
Food Waste	52.0	68.6	73.4	71.8	73.5	56.0	61.43
Packaging Waste	34.0	31.4	26.6	28.2	26.5	40.2	38.57
Other	14.0	-	-	-	-	4.0	-
Volume[a]							
Food Waste	-	28.1	16.7	21.8	24.9	22.9	15.03
Packaging Waste	-	71.9	83.3	78.2	75.6	70.6	84.97
Other	-	-	-	-	-	6.5	-

Adapted from Ferris, et al. (1994).
[a] Uncollapsed volume used, except for Pettay (1992).
[1] Environmental Defense Fund and McDonald's Corporation (1991).
[2] Pettay (1992).
[3] King (1993), Non-Commissioned Officers Academy dining facility.
[4] Ferris, et al. (1994).
[5] Hollingsworth, et al. (1992).
[6] Ferris (1995).

[7] See, for instance, Dilly (1998), Ferris (1995), Kim, et al. (1997), King (1993), and Hollingsworth, et al. 1992).

A number of studies have also characterized solid waste generation in the food retail industry, with a range of results. In 1991, the Food Marketing Institute conducted a waste composition survey of 27 retailers and wholesalers. Respondents were organized into three categories: wholesalers, large supermarket chains (more than 50 stores) and small supermarket chains (50 or fewer stores). In the case of the large supermarket chains, the estimated waste composition showed 84% corrugated, 10% food, 2% paper, and 4% other. The small supermarket chains, in contrast, showed 46% corrugated, 43% food, 4% glass, 4% plastic, and 3% other. The Task Group conducting the survey concluded that the waste composition for the small chain best represents the typical retail supermarket (Composting Council Research and Educational Foundation, 1997). Other waste characterization analyses of food retail operations have found similar waste compositions (NYDEC, 1997; Beck, 1997; Lieb, 1994).

Both food waste and packaging constitute significant portions of the overall municipal solid waste stream. Food waste alone accounted for 10.1% (by weight) of the materials generated in the 1997 municipal solid waste stream (EPA, 1999d), much of which comes from the foodservice and food retail industries, with the balance generated at the food processing level or by consumers during home preparation and consumption. With respect to packaging, materials generated in foodservice and food retail operations, too, are prominent in the solid waste stream, though they constitute only small portions of larger categories (e.g., paper and paperboard, plastics, glass). Food waste and packaging are each discussed separately below.

Food Waste

Food waste represents a specific category of solid waste prevalent in both foodservice and food retail operations. Numerous analyses have reported that food waste, sometimes referred to as food residuals, is the major waste stream generated in foodservice operations (Kim, et al., 1997; Ferris, et al., 1995; King, 1993; Hollingsworth, et al., 1992; Pettay, 1992). In its annual study of the U.S. municipal solid waste stream, the EPA found that 21.9 million tons of food waste was generated in 1997, representing the third largest category of solid waste (EPA, 1999d). This total includes food waste from both foodservice and food retail establishments, and was defined as uneaten food and food preparation wastes from residences and commercial and noncommercial

foodservice establishments. In terms of its proportion of the municipal solid waste stream, food waste over the past 40 years has generally remained constant, ranging from 8.6% to 13.8%; throughout the 1990s it has been about 10% of the total. In terms of total weight, the amount of food waste generated in the 1990s has measured nearly double historical amounts, but this increase is attributed in large part to improvements in sampling and measurement techniques (EPA, 1998c).

A second recent study completed by researchers from the USDA's Economic Research Service (ERS) estimated total food wastes to be much higher. According to their estimates, in 1995, 96.3 billion pounds (48.2 million tons) of food was lost by food retailers, foodservice operators, and consumers. Of this total, 90.8 billion pounds (45.4 million tons) of food was lost by consumers and foodservice outlets and 5.4 billion pounds (2.7 million tons) of food was lost at the retail level (Kantor, et al., 1997).[8] The breakdown of food losses is detailed in Table 3.4. The reason the ERS aggregate estimate far exceeds that of the EPA analysis is largely the result of differences in definition. In the ERS study, food losses included all edible food, whereas EPA limited its analysis to that of food waste generated as part of the municipal solid waste stream (For example, the ERS study included fluid milk while EPA did not.).

The ERS found that food losses at the foodservice and consumer level accounted for 27% of the edible food available for consumption in 1995. Half of this amount consisted of losses in highly perishable foods, such as fresh fruits and vegetables, fluid milk, and grain products (Kantor, et al., 1997). Food waste is generally of three types: leftovers—prepared foods that have not been served to customers and may be suitable for later consumption, production wastes—foods generated in the production of food for consumption (e.g., fruits and vegetable peels, meat scraps), and service or plate wastes—foods discarded by consumers (Dilly, 1998). Studies of all types of foodservice operations have identified numerous sources of food waste generation. Common sources include over-preparation of menu items, expanded menu choices which complicate food inventories, unexpected fluctuations in food sales due to unforeseen changes in weather or other factors beyond the control of foodservice operators, excessively large servings,

[8] Totals do not add due to rounding.

TABLE 3.4. FOOD LOSSES FROM EDIBLE FOOD SUPPLY AT RETAIL, FOODSERVICE, AND CONSUMER LEVELS FOR SELECTED FOODS, 1995

		Losses from Edible Food Supply					
	Edible Food Supply	***Food Retail***		***Foodservice and Consumers***		***Total***	
Commodity	*Million pounds*	*Million pounds*	*Percent*	*Million pounds*	*Percent*	*Million pounds*	*Percent*
Grain Products	45,606	912	2.0	13,682	30.0	14,594	32.0
Fruit	48,338	707	1.5	10,609	21.9	11,316	23.4
Vegetables	63,077	999	1.6	14,947	23.7	15,946	25.3
Dairy Products	76,276	1,525	2.0	22,883	30.0	24,408	32.0
Meat, Poultry, & Fish	51,466	515	1.0	7,720	15.0	8,235	16.0
Eggs	7,918	158	2.0	2,328	29.4	2,486	31.4
Dry Beans, Peas, & Lentils	2,263	23	1.0	336	14.8	359	15.9
Tree Nuts & Peanuts	1,861	19	1.0	276	14.8	295	15.9
Caloric Sweeteners	38,287	388	1.0	11,473	30.0	11,861	31.0
Fats & Oils	20,250	203	1.0	6,564	32.4	6,767	33.4
Total*	355,883	5,449	1.5	90,818	25.5	96,266	27.0

*Totals may not add due to rounding.

Source: Kantor, et al. (1997).

and receipt of unwanted or unselected food at noncommercial establishments such as healthcare facilities (Kantor, et al., 1997; Dilly, 1998).

With respect to the retail level, the ERS determined that food losses accounted for about 2% of the edible food available for consumption in 1995. About half of the loss took the form of fluid milk and other dairy products and fresh fruits and vegetables. The ERS identified numerous reasons that retail operators discard food, such as overstocking, overtrimming, improper stock rotation, and post-holiday discard of seasonal items. Additional reasons include the removal of stock from shelves when products reach their "sell-by" date, especially the perishable foods that are increasingly offered in retail operations through in-store bakeries, delicatessens, and other specialty services. Losses from non-perishable foods are less frequent (e.g., removal of canned fruits and vegetables, cereals, and pastas due to damaged packaging), constituting about 10% of total food retail losses (Kantor, et al., 1997).

Disposal of food waste is most commonly done through either transportation to a landfill or garbage disposals connected to a sewer system. Foodservice and food retail outlets do to some degree rely on alternative methods of disposal, including source

reduction, recycling, and incineration. Methods of source reduction include improved menu planning, food purchasing, food preparation, and portion control (Dilly, 1998). The most common form of recycling of food wastes is through composting. A nationwide survey found that, in 1997, there were 220 commercial composting sites (in 6 states) for food wastes. The study also found that about 68% of these composting sites accepted production food wastes, and about 50% accepted service food wastes from restaurants and cafeterias (Goldstein, 1997; Dilly, 1998).

Despite the increased use of composting in recent years, it is still an infrequently practiced method of food waste disposal for most foodservice and food retail operations. A recent survey by the Food Marketing Institute found that of the 108 companies polled, few had stores with active composting programs (FMI, 1997d). Due to these low levels of composting and other methods of recycling, food wastes are characterized by low levels of recovery (removal of materials from the municipal solid waste stream for the purpose of recycling, including composting). In 1997, less than 1% (by weight) of food wastes were recovered, and, as a result, food wastes were the second largest single source of discards (waste remaining after recovery) in the municipal solid waste stream (EPA, 1999d).

Packaging Materials

The composition of packaging materials in the solid waste stream of foodservice operations varies by type of operation. Table 3.5 summarizes the results from several characterization studies. Most of these studies found corrugated cardboard and paper to be the largest packaging components. Corrugated cardboard is primarily used as secondary or tertiary packaging (packaging used to bring the product to the foodservice outlet, while paper is used as both primary (packaging that usually goes home with the consumer) and secondary packaging (Ferris, et al., 1994). Other important types of solid waste generated by foodservice operations include glass, especially in hotel food and beverage operations that include bars, and metals and plastics in the educational foodservice operations. No industry-wide data exist on the level of recycling of corrugated boxes, paper products (paper products that have come in contact with food cannot be recycled), glass, and metal; however, these materials are among the

TABLE 3.5. PACKAGING WASTE IN SELECTED FOODSERVICE OPERATIONS, BY WEIGHT

	Commercial		Noncommercial				
	2 McDonald's Restaurants[1]	2 hotel food and beverage operations[2]	Military[3]	University[4]		School Foodservice (6 schools)[5]	Extended Care Facility[6]
				Conventional	Convenience		
Percent of Operation's Waste Stream							
Total Packaging Waste	34.0	31.4	26.6	28.2	26.5	40.2	38.57
Corrugated Paperboard	-	7.4	-	10.3	9.1	29.0	11.03
Metals	-	2.3	-	3.0	2.4	15.4	-
Aluminum	-	0.1	-	0.5	0.3	-	-
Paper (and Paperboard)	11.0	1.9	-	10.6	9.8	-	6.62
Plastic	7.0	0.7	-	3.8	4.9	-	-
Glass	-	19.0	-	-	-	-	-
Wood	-	-	-	0.5	0.6	-	-

Adapted from Ferris, et al. (1994).
[1] Environmental Defense Fund and McDonald's Corporation (1991).
[2] Pettay (1992)
[3] King (1993), Non-Commissioned Officers Academy dining facility.
[4] Ferris, et al. (1994)
[5] Hollingsworth, et al. (1992).
[6] Ferris (1995).

components of the municipal solid waste stream with the highest levels of recovery (EPA, 1999d).

Interestingly, much of the recent discussion of the solid waste generated as part of foodservice operations has centered on serviceware materials. A recent study has shown that, in terms of contribution to the municipal solid waste stream, foodservice disposables account for only 0.9% by weight, and 1.51% by volume (FPI, 1997). Despite the fact that these materials make up a relatively small proportion of the municipal solid waste stream, the use of disposable serviceware (single use) as opposed to reusable serviceware (permanentware) has been a subject of active debate in the foodservice industry. The dispute has often been erroneously reduced to comparisons of two specific products and their environmental soundness with respect to one specific environmental impact.[9] More

[9] For instance, Tierney (1996) compared one reusable item, a ceramic cup, and one disposable item, a polystyrene mug, and suggested that since the polystyrene cup required less energy to produce compared with the ceramic mug, disposables were generally more environmentally sound than reusables.

appropriately, the determination of the environmental impacts of various types of serviceware should be based on life-cycle analyses of products, including consideration of the raw materials extracted, the energy requirements for production, manufacturing, use, and final disposal, and air and water impacts. Analyses of this type have shown that there is no clear choice between different types of serviceware; rather, overall environmental impacts depend on which endpoint is emphasized (Feldman, 1991; Denison and Ruston, 1996; Franklin Associates, 1991).

In the early 1990s, the debate on serviceware materials centered on the use of polystyrene, a type of plastic foam used in many foodservice operations. Environmental concerns about polystyrene generally regarded its materials base (including benzene which EPA has classified as a carcinogen and ozone-depleting chlorofluorocarbons) and its contribution to the solid waste stream. Some restaurants switched from polystyrene to alternative packaging materials, the most high-profile example of which was McDonald's decision to switch its sandwich packaging from polystyrene to paper in November 1990.[10] Additionally, many municipalities imposed bans on the use of polystyrene in foodservice operations (e.g., Portland, Oregon; Berkeley, Santa Cruz, and Carmel, California) (Scarpa, 1990).

With respect to food retail operations, in 1993, 25.4 million tons of grocery packaging (including packaging used to unitize, protect, and ship food, beverage, and nonfood grocery products to the consumer through grocery stores and other retail outlets) was generated. This total represented 12.3% of that year's total municipal solid waste, a decline from 15.3% in 1980. Grocery packaging in 1993 accounted for more than one-third of the total containers and packaging found in the municipal solid waste stream (Franklin Associates, 1995).

Packaging wastes from grocery stores are not unique in terms of materials, and typically include corrugated cardboard, paper, plastics, steel, aluminum, glass, and wood. As with foodservice solid waste, grocery packaging is typically categorized as primary (e.g. metal cans, milk cartons) and secondary (e.g. corrugated boxes, pallet wrap, wood pallets, and plastic crates). Franklin Associates (1995), in a report prepared for the Grocery Manufacturers of America, found that from 1990 to 1993, primary packaging

[10] For a summary of this decision, see Svoboda (1995).

increased by less than 1%, while secondary packaging increased by 15%. Table 3.6 shows the changes since 1970, including projections to the year 2000. The rise in secondary packaging is attributable in large measure to a widened distribution area, as food products are increasingly being shipped across the United States and to international markets. The increase in fresh produce delivery has also required the use of more secondary corrugated containers (Franklin Associates, 1995).

TABLE 3.6. GROCERY PACKAGING GENERATION, BY PACKAGING TYPE

	1970	***1980***	***1990***	***1993***	***2000***
Type of Grocery Packaging			*Thousand Tons*		
Primary Packaging	13,090	16,900	14,730	14,820	15,180
Secondary Packaging	3,070	6,260	9,160	10,550	12,160
Total	16,160	23,160	23,890	25,370	27,340

Source: Franklin Associates (1995).

Though secondary packaging has been on the rise over the past couple of decades, so too has the amount of waste recovered. Grocery packaging recovery increased from only 860 thousand tons of waste in 1970 to 8.4 million tons in 1993, with growth projected to continue (Franklin Associates, 1995). In its report, Franklin Associates (1995) identified numerous reasons for the rise in the recovery of grocery packaging waste: continued use of recycled material in glass, steel, aluminum, and paperboard packages; technological advancements in plastics recycling; development of an effective infrastructure for recovering secondary packaging (especially corrugated containers); increased recycling rates for aluminum beverage containers, steel food and beverage cans, glass containers, and plastic milk, detergent, and soda bottles; and increased public awareness and participation in curb-side recycling programs and other recycling programs for consumers (collection points at retail stores). Additionally, opportunities to save on storage space and to lower disposal expenses have encouraged food retailers to seek strategies (e.g., recycling, composting) for reducing solid waste generation (Lieb, 1994).

Several national food retailing chains have taken steps to reduce their solid waste generation. Oakland-based Safeway, the second largest chain in terms of 1998 sales, has set up recycling programs in its stores nationwide. Though the company had been recycling corrugated containers for 20 years, beginning in 1990 many Safeway stores started new programs, including recycling of plastic and paper bags, sale of reusable bags, and use of more recycled-content in Safeway brand items (Lieb, 1994). San Antonio-based H.E.B. Grocery recycles cardboard and front-end bags, pallets, and pallet wrap (at both the retail and warehouse level), and is running a pilot composting project in Houston (Progressive Grocer, 1997c). Smaller supermarket chains have also taken steps to reduce their solid waste generation. Larry's Markets, a five-store Seattle-based chain, implemented a program in late 1991 that includes extensive recycling and composting programs and has a goal of zero waste by the year 2000 (Lieb, 1994). These types of efforts have led to the overall increase in the recovery of grocery packaging waste, though, in 1994, recovery still only accounted for about a third of the grocery packaging generated.

Air Emissions

Foodservice and food retail operations are themselves generally not significant sources of air pollution. However, as intensive users of energy they contribute and/or exacerbate some air pollution problems, though to a lesser extent than sources such as heavy industry, utilities, and vehicles. There are no data available on the portion of total emissions of specific pollutants that can be attributed directly to the foodservice and food retail industries. Part of the difficulty in measuring air emissions on an industry-wide basis is that emissions from individual foodservice and food retail operations are typically small, and, thus, generally do not require federal permits under the National Ambient Air Quality Standards (NAAQS) program of the Clean Air Act. The one exception is emissions from vent hood systems of foodservice equipment which are regulated as part of the NAAQS program, and have been targeted in some parts of the nation (Mason, 1996).

In 1997, the South Coast Air Quality Management District (AQMD) became the first regional air board to impose regulations on restaurant air emissions (Ruggless, 1998). The South Coast AQMD found that the 31,000 restaurants in the Greater Los

Angeles area emit 11.6 tons per day of fine particulate matter and 1.6 tons per day of volatile organic compounds (VOCs), making foodservice the fourth largest man-made source of these pollutants in the area. The control measure adopted by the South Coast AQMD requires 800 quick-service restaurants using chain-driven charbroilers (three-fourths of which are Carl's Jr. and Burger King units) to install catalytic converters to reduce emissions by an estimated 90% (South Coast AQMD, 1997; Martin, 1997).

Though this rule was targeted at chain-driven charbroilers, more recent research by the South Coast AQMD has shown that other types of foodservice cooking equipment are more significant sources of particulate matter and VOCs. With respect to the sources of particulate matter, the South Coast AQMD found that chain-driven charbroilers account for only 0.4% of emissions, whereas under-fired charbroilers account for 83%, and griddles for 13%. In terms of VOCs, chain-driven charbroilers were found to account for about 13% of emissions, under-fired charbroilers for 69%, griddles for 13%, and deep fat fryers for about 6%. Based on these data, the South Coast AQMD expects to next target under-fired charbroilers for control measures (South Coast AQMD, 1999). Though the action taken in California was the first of its kind by a regional air quality board, other jurisdictions have considered similar regulations on foodservice air emissions from charbroilers, including the state of Arizona (Ruggless, 1998) and the city of Aspen, Colorado (Romano, 1993).

Indoor air pollution is also an issue for foodservice operations, especially with respect to environmental tobacco smoke (secondhand smoke). In its 1992 study, the "Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders," the EPA concluded that exposure to environmental tobacco smoke is responsible for approximately 3,000 lung cancer deaths each year in nonsmoking adults. The EPA also found that exposure worsens the condition of an estimated 200,000 to 1,000,000 asthmatic children, and increases children's risk to lower respiratory tract infections such as bronchitis and pneumonia (EPA, 1992). Though a 1998 court ruling vacated EPA's finding that environmental tobacco smoke was a known carcinogen, public health advocates contend that the decision was based predominantly on procedural grounds, and did not repeal the scientific basis of the study (Liddle, 1998). A recent study has provided additional evidence of the health effects of environmental tobacco smoke. Researchers at

the University of Auckland in New Zealand found that breathing in secondhand smoke increased nonsmokers' risk of suffering stroke by 82% (Ross, 1999).

A study by Siegel (1993) working with the Office on Smoking and Health of the Centers for Disease Control and Prevention, concluded that employees of the foodservice industry face an increased risk of lung cancer from exposure to environmental tobacco smoke. This study concluded that levels of environmental tobacco smoke in restaurants was approximately 1.6 to 2.0 times higher than in office workplaces and 1.5 times higher than in residences with at least one smoker. Smoke levels in bars were found to be 3.9 to 6.1 times as high as office workplaces and 4.4 to 4.5 times as high as residences. Furthermore, the epidemiological evidence suggested that there may be up to a 50% increase in the lung cancer risk among restaurant waiters that, in part, is attributable to environmental tobacco smoke exposure in the workplace (Siegel, 1993).

In response to such studies, and also to protect the health and preferences of foodservice customers, smoking has been prohibited in many foodservice operations. To date, five states (California, Vermont, Maryland, Utah, and Maine) have approved and/or implemented strict restrictions on smoking in restaurants and bars as have many major cities (e.g., New York, Boston, and San Francisco) and scores of municipalities (Allen, 1999; Allen 1998; Americans for Nonsmokers' Rights, 1999). Additionally, numerous restaurants have unilaterally banned smoking within their establishments including McDonald's and Arby's (Allen, 1997).

Water Emissions

Foodservice and food retail operations are point sources of water pollution, but are generally too small to trigger the permitting requirements of the National Pollution Discharge Elimination System (NPDES) of the Clean Water Act. Restaurants and supermarkets usually discharge directly into municipal sanitary sewer systems and, thus, if regulated, fall under the jurisdiction of the municipality in which they operate. Many local governments have regulations in place that establish the amounts of solids that may enter the wastewater system, typically based on the biological oxygen demand (BOD) of wastewater from facilities. These regulations often require foodservice operators to obtain a wastewater permit, though this is less common for food retail operators (Mason, 1996).

No industry-wide data are available regarding water emissions from foodservice establishments to municipal sanitary sewer systems. The main concerns to wastewater treatment facilities, however, are generally grease and food wastes. One study conducted by the City of Albuquerque over four years traced 42% of grease and food waste in the city's sewer system to commercial foodservice establishments. To respond to the problem, the city imposed a surcharge on water use on foodservice operators to defray some of the treatment costs (Nichols, 1994). Other cities have responded to similar discharges to local sewer systems with surcharges on water use or prohibitions on the use of commercial garbage disposals (Dilly, 1998; Bertagnoli, 1995). Examples of cities prohibiting commercial disposals include New York, Las Vegas, and New Orleans (Lorenzini, 1993). Such regulations have led many foodservice operations to use alternative systems such as pulpers which reduce both the amount of water used in disposal as well as the overall waste discharged into the sewer system (Frables, 1996).

Food Safety—Foodborne Diseases

Though the U.S. food supply is widely recognized as the safest in the world, government officials,[11] public health agencies,[12] and industry trade associations[13] are giving increasing attention to food safety. Consumers, too, have expressed increased concern about food safety issues. According to a 1998 survey conducted by the CMF&Z Food Practice Group and the International Food Safety Council, consumers for the first time ranked food safety as the most important issue among a group that included crime prevention, safe drinking water, health and nutrition, and environmental issues (Food Engineering, 1998). The safety of food can be jeopardized in numerous ways, with most contamination occurring at early stages of the food marketing system, either at the level of production (e.g., E. Coli contamination of fresh produce) or processing (e.g., Listeria

[11] The 106th Congress is considering enactment of a food safety bill, The Consumer Food Safety Act of 1999 (H.R. 1616, S. 908); the Clinton Administration issued Executive Order 13100 in August 1998, which established the President's Council on Food Safety to, among other things, develop a comprehensive strategic Federal food safety plan.

[12] In 1995, the Centers for Disease Control, in collaboration with the U.S. Department of Agriculture, and the U.S. Food and Drug Administration established the Foodborne Diseases Active Surveillance Network (FoodNet) to track foodborne diseases and related epidemiological studies to help public health officials better understand food safety issues.

[13] In June 1999, the Food Marketing Institute and the National Restaurant Association Educational Foundation announced the establishment of a joint venture to widen a food safety certification program,

contamination of processed beef). Foodborne illnesses, however, can also stem from the transmission of foodborne pathogens at the level of foodservice and food retail operations.

According to the latest data from the Centers for Disease Control and Prevention (CDC), 76 million people are sickened, 325,000 are hospitalized, and 5,000 die annually from food poisonings (Mays, 1999). Recent studies, furthermore, indicate that foodborne illnesses are on the rise (GAO, 1996; Collins, 1997; Tauxe, 1997). The overall economic cost of foodborne illnesses is not known, though the ERS has estimated that the medical costs, loss of productivity costs, and other illness-specific costs (e.g., special education costs, residential-care costs) for seven pathogens range from $6.5 billion to $34.9 billion (Buzby and Roberts, 1996).

The Council for Agricultural Science and Technology (1994) has estimated that 40 different foodborne pathogens cause human illnesses. These pathogens can be divided into four categories—bacterial, fungal, parasitical, and viral. Illness, and in serious cases mortality, may result from each of these types of pathogens. The most common outbreaks of foodborne illnesses are attributed to bacterial pathogens. See Table 3.7 for the estimated number of cases and deaths for the major bacterial pathogens causing foodborne illnesses.

The CDC (1996) found that during the years 1988-1992, the contributing factors associated with reported foodborne disease outbreaks were, in order of frequency, improper holding temperatures, poor personal hygiene, inadequate cooking, contaminated equipment, and food from an unsafe source. While food contamination can occur at any point in the food marketing system, the findings of the CDC indicate that it is often caused by the mishandling of food during preparation, obviously a central activity in foodservice operations. There is no official estimate of how many of the 76 million estimated annual cases of foodborne illnesses result from eating in restaurants and other foodservice operations (DeWaal and Dahl, 1996). The CDC (1996), however, indicates that, from 1988 to 1992, 40% of all reported outbreaks were traced to food eaten at restaurants, delicatessens, and cafeterias. Table 3.8 summarizes some of the larger

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ServSafe®, to more retail managers. More than 800,000 foodservice professionals have already been certified in the ServSafe® program. See Featsent (1998).

TABLE 3.7. ESTIMATED CASES OF ILLNESS AND DEATH FROM MAJOR BACTERIAL PATHOGENS, 1996

Bacterial Pathogen	*Estimated Annual Cases*	*Estimated Annual Deaths*	*Estimated Share Foodborne*	*Foodborne Annual Cases*	*Foodborne Annual Deaths*
	Number		*Percent*	*Number*	
Campylobacter jejuni or coli	2,000,000-10,000,000	200-730	55-70	1,100,000-7,000,000	110-511
Clostridium perfringens	10,000	100	100	10,000	100
Escherichia coli	10,000-20,000	100-250	80	8,000-16,000	80-200
Listeria monocytogenes	1,092-1,860	270-510	85-95	928-1,767	230-485
Salmonella	800,000-4,000,000	1,000-2,000	87-96	696,000-3,840,000	870-1,920
Staphylococcus aureus	8,900,000	1,000-2,000	17	1,513,000	454

Source: Crutchfield, et al. (1997)

foodborne illness outbreak reports that have been traced back to the mishandling of food in restaurants.

There are also no precise estimates of how many foodborne illnesses originate from food retail operations, though considerable opportunities exist for the mishandling of food in this industry as well. For one, foodservice within supermarkets is becoming standard. As was noted previously, 83.6% of supermarket retailers featured foodservice in 1998, and consumers are now purchasing an equivalent amount of take-out foods from supermarkets as from traditional restaurants (excluding fast food outlets) (FMI, 1998a; FMI, 1998b). This suggests that food retail operations are preparing an increasing amount of food, thus, raising the opportunity for contamination and the outbreak of foodborne illnesses. Foodborne diseases have also been linked to foods previously considered safe. In addition to contaminated meats and unpasteurized milk, foodborne illness outbreaks have been on the rise from different foods, including the fresh produce carried by most grocery retailers. Researchers at the CDC reported 13 separate foodborne illness outbreaks traced to fresh produce from 1990 to 1996, including contamination of cantaloupes, tomatoes, strawberries, scallions, alfalfa sprouts, leaf lettuce, and raspberries. Though the contamination may have occurred prior to the produce reaching the store, unsanitary handling or cross-contamination conceivably may have occurred at the store level (Tauxe, 1997).

TABLE 3.8. RECENT FOODBORNE ILLNESS OUTBREAKS TRACED TO RESTAURANTS

Date	*Description*	*Location*	*# of Cases*	*Cause*
6/96	*Salmonella*-contaminated food	Massachusetts	38	Employees did not wash hands prior to handling food.
9/95	*E. Coli* O157:H7-contaminated beef	Idaho	11	Raw food cross-contaminated other food.
8/95	*Salmonella Newport*-contaminated chicken	Florida	850	Raw food cross-contaminated other food; raw meat was kept on cutting board with vegetables.
1/95	*Hepatitis A*, contaminated food	Utah	95	Food was contaminated by human fecal matter from handling of food without hand-washing
8/94	*Salmonella*-contaminated hollandaise sauce	Washington, DC	56	Holding temperature was too low.

Source: DeWaal and Dahl (1996).

Government oversight of food safety is shared among several different agencies, most notably the Food and Drug Administration (FDA) and the USDA. State and local government agencies have their own food safety programs and conduct most inspections at foodservice and food retail operations (Taylor, 1997). To assist these state and local agencies, the FDA has issued a *Food Code* which provides expert guidance on technical issues and regulatory standards and issues national standards on issues such as cooking temperatures, cooling procedures, and refrigeration (Taylor, 1997; Collins, 1997). At least one study, however, has suggested that local government agencies are generally not enforcing the standards outlined by the *Food Code* (DeWaal and Dahl, 1996).

The foodservice and food retail industries have begun to respond to food safety issues. Many operators have adopted “Hazard Analysis and Critical Control Point” (HACCP) systems to reduce the chances that foodborne illnesses emanate from their handling of food. Already incorporated into the operations of many food manufacturers, HACCP is a seven-step process, which includes: 1) identification of hazards and assessment of risks at each phase in the process, 2) determination of critical points where hazards can be controlled, 3) establishment of criteria and limits for each critical point, 4) creation of procedures to monitor critical points, 5) establishment of corrective actions when needed, 6) initiation of record-keeping for the system, and 7) verification of system effectiveness (Larson, 1997).

Other important food safety issues include the potential health effects of pesticide residues on food, and the increasing use of antibiotics, genetic modification, and hormones. Since these food safety concerns originate from activities occurring at earlier stages of the food marketing system—most commonly production or processing—they do not represent direct environmental impacts of the foodservice and food retail industries. Foodservice and food retail operators, however, do have the opportunity to use their upstream leverage to reduce the potential risks posed by these other issues, as is discussed in Section 4.

Refrigerants

Chlorofluorocarbons (CFCs) are synthetic chemicals used for many purposes including as aerosol sprays, blowing agents for foams and packing materials, solvents, and refrigerants. This last category is most relevant for foodservice and food retail operations. CFCs are used as cooling agents in many refrigeration and cooling systems including refrigerators, freezers, chillers, and air conditioners. Though use of these systems is not unique to foodservice and food retail operations, such operations are the largest commercial users of refrigeration, (23.6% and 39.0%, respectively), and also are significant commercial users of cooling, (7.4% and 2.6%, respectively) (DOE/EIA, 1998).

The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer and its subsequent amendments mandated that participating countries phase out the production and consumption of CFCs and other ozone-depleting substances. Production in the United States and other developed countries was banned as of December 31, 1995. EPA issued numerous related regulations in 1993 pursuant to Title VI of the Clean Air Act Amendments of 1990. Entitled "The National Recycling and Emission Reduction Program," these regulations require persons working on refrigeration and air-conditioning systems containing CFCs to maximize the recapturing and recycling of CFCs during the maintenance, service, and disposal of these systems (EPA, 1997).

These regulations left foodservice and food retail operators with a few options on how to deal with CFC-refrigerants—recycle refrigerants, retrofit equipment for CFC-free compounds, or replace equipment with CFC-free equipment (Mason 1996). The full extent to which foodservice and food retail operations on an industry-wide basis have

begun to use alternative refrigerants is unclear, though there is some survey evidence on the retail side. The regulations prompted the food retail industry, the most significant commercial users of refrigeration, to recommend the establishment of a refrigerant management program with five main components: (1) training and certification of technicians, (2) refrigerant removal through the use of EPA-approved recovery equipment, (3) reduction of refrigerant leakage rates through leak detection and containment, (4) reclamation of recovered refrigerant, and (5) reuse of reclaimed refrigerant and record-keeping of all refrigerant usage (FMI, 1995). A 1995 survey by the Food Marketing Institute (1995) found that 77% of supermarket operators had followed industry recommendations to adopt a refrigerant management program. Additionally, survey respondents indicated that remodeled or new stores were moving away from CFC use toward alternative refrigerants. A subsequent survey by the Food Marketing Institute (1997d) found that food retail companies were using alternative refrigerants "most of the time."

There are some notable examples of grocery stores and restaurant chains that have pursued aggressive CFC policies, including the phase-out of CFCs in favor of alternative refrigerants. The Jitney Jungle Stores of America, a private supermarket chain of 198 stores across six states (Alabama, Arkansas, Florida, Louisiana, Mississippi, and Tennessee) became the first chain in the United States to design and build a new store that exclusively used a non-CFC refrigerant (HP-80) in all of its large refrigeration systems. After a successful test in its new store in Forest, Mississippi, the company initiated a program to eliminate CFCs from all its stores' equipment by the end of 1995 (EPA, 1993). In the foodservice industry, many restaurants have pursued policies to shift from CFCs to alternative refrigerant compounds. Domino's Pizza, for instance, modified its cooling systems in 1992 to use alternative refrigerants that have only 5% of the ozone-depleting potential (Freeman, 1992). Emil Villa's Hick'ry Pit, a chain of 12 restaurants in the San Francisco area, initiated a program to eliminate use of CFCs in all of its restaurants by the end of 1993 (EPA, 1993).

Land Use Impacts

The land use impacts of siting decisions are potentially an important, yet indirect, environmental impact of the foodservice and food retail industries. To date, geographical

studies of these industries have focused predominantly on a community's access to these services, with particular emphasis on access to supermarkets in urban areas (Gottleib, et al., 1996; Cotterill and Franklin, 1995). The potential locational effects of new developments, however, should also be evaluated in terms of their impacts on regional growth patterns. These issues are increasingly garnering attention as part of the growing consideration of "urban sprawl." Short of further systematic analysis, though, it is difficult to estimate the total land use impacts of the foodservice and food retail industries.

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This section surveyed the direct environmental impacts of the foodservice and food retail industries. It is difficult to evaluate these service sectors on an industry-wide basis. With respect to each of the environmental impacts discussed, there is likely a wide variance in performance throughout each industry. Some companies (and individual establishments) have unquestionably devoted considerable attention and resources to environmental stewardship, whereas others have generally not given much attention to their contribution to environmental problems.

In general, the direct environmental impacts of these industries do not represent urgent concerns in terms of posing significant and immediate risks to human or ecological health, with the important exception of foodborne pathogens. This section however, highlights areas that operators in these industries can target to reduce the effect their service provision has on the environment. Furthermore, it illustrates that the activities of the foodservice and food retail industries do leave an imprint on environmental quality. As the next section shows, this imprint extends beyond the restaurant or store level, and stretches into the upstream components of the food marketing system.

4. UPSTREAM ENVIRONMENTAL IMPACTS

The previous section addressed the direct environmental impacts of foodservice and food retail operations. Limiting discussion of the environmental implications of these industries to their retailing components alone, however, fails to recognize that there are environmental impacts at other stages of the food marketing system that the foodservice

and food retail industries can affect. In other words, the environmental reach of these industries goes beyond that of the store or restaurant, and extends into other segments of the food marketing system.

The foodservice and food retail industries play a key intermediary role in the food marketing system. At one end, these industries are the dominant marketing channel for consumers. With some exceptions,[14] most food products are purchased by consumers from either foodservice or food retail establishments. At the other end, these industries are simultaneously the largest customers for food manufacturers and, by extension, food producers. In this unique position, these industries function as arbiters or gatekeepers through their determination of which foods are available to consumers. Commercial and noncommercial foodservice operations exercise this influence through their menu offerings and decisions about which ingredients they use in their meals. Food retailers exert this power through decisions about which products to carry on their shelves and in the determination of how much shelf space to allocate to each product (Connor and Schiek, 1997).

In this role, the foodservice and food retail industries are in a strong position to influence upstream environmental activity, through what is often referred to as “green supply” or supply chain environmental management. “Green supply” generally refers to the ways in which supply chain management and industrial purchasing can be used to improve the quality of the environment (Green, et al., 1996). Examples include screening suppliers for environmental performance, working collaboratively with suppliers on environmentally sound design initiatives, and providing training and information to strengthen supplier's environmental management capacity. Companies pursue supply chain environmental management initiatives for reasons other than simply improving their environmental stewardship, including searching for ways to reduce costs, improving risk management, enhancing quality, increasing innovation and new product development, and bolstering brand image (Business for Social Responsibility, 1999).

[14] The most notable exception is the direct marketing channel. Direct marketing refers to a circumvention of the predominant distribution channels, generally by producers or processors bypassing the wholesaling and retail component of the distribution system and instead marketing their products directly to the consumer. The most common example of direct marketing is the farmers' market, but other examples include community-supported agriculture and direct home delivery by manufacturers.

In the context of the foodservice and food retail industries, consideration of ways to reduce environmental impacts through the supply chain is complicated. No single supply chain serves these industries. Rather, the supply chain, or more generally the food distribution system, comprises a complex web of channels and participants. For example, while a single food product may be handled by a number of different brokers and travel through several warehouses, another food product may circumvent brokers and warehouses altogether. That said, foodservice and food retail companies do have some important opportunities to affect upstream environmental performance through incorporation of environmental criteria into their own upstream operations, their dealings with other food marketing companies, and in their purchasing decisions. Furthermore, the capacity of foodservice and food retail companies to leverage their influence to promote environmental gains is augmented by three significant trends in the food marketing system—consolidation and concentration, vertical coordination between food manufacturing and production, and initiatives to improve supply chain efficiency—each of which is briefly discussed below.

The recent wave of consolidation in the food marketing system has fueled an already growing trend toward greater market concentration. In terms of U.S. farm production, for instance, 2% of farms produced half of the sales of agricultural products in 1997 (USDA/ERS, 1999a). The food manufacturing and wholesaling industries have also been characterized by growing concentration, with estimated 1992 top 50 firm aggregate concentrations of 50.0% and 79.5%, respectively (Connor and Schiek, 1997). In combination with the consolidation and concentration in the foodservice and food retail industries discussed in Section 2, the food marketing system is, thus, increasingly dominated by fewer and larger companies.

While this level of concentration raises important issues regarding competition (both monopoly and monopsony), these trends may work in favor of improving environmental management. In one respect, the environmental impacts of different functions of the food marketing system are concentrated within a smaller number of large companies, meaning that enhanced environmental management efforts by only a few companies can potentially have broad benefits. (Of course, the reverse is also true.) Additionally, “greener” manufacturers, distributors, or retailers may be able to market

their efforts to gain competitive advantage, forcing rivals to adopt similar steps, ultimately leading to improved environmental performance on an industry-wide scale. This logic suggests that changes in retailer environmental decision-making, especially by a large foodservice or food retail operator (e.g., McDonald's or Kroger), can permeate through the industry, resulting in significant positive impact on overall environmental quality.

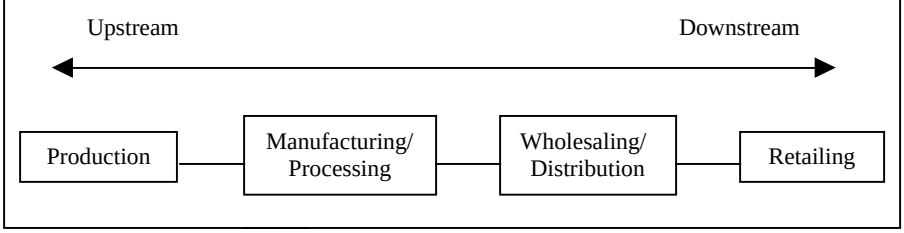
There has also been a shift toward higher levels of vertical coordination in the food marketing system, generally, and in food production and manufacturing, specifically. (See Box 4.1 for a general discussion of vertical coordination.) An important part of what is increasingly referred to as the industrialization of agriculture,[15] this trend represents a shift of decision-making in which production decisions are increasingly made by food processors and marketers, rather than by individual farmers (Welsh, 1997). The percentage of total farm output produced under vertical integration or contractual arrangements has increased steadily since 1960 (Lipton, et al., 1998) and, in 1993, contract production alone accounted for about 32% ($47 billion) of the total value of production (USDA/ERS, 1996). Vertical coordination is more common for some commodities than others, including for many high-value crops (e.g., fruits and vegetables) (Barkema, 1993). Nearly all chickens and turkeys are now raised under direct contractual arrangements between growers and food companies (Lipton, et al., 1998). Additionally, contract production and, to a lesser extent vertically integrated firms, are replacing hog purchases on the open market; in 1998, almost 40% of hog sales to packers were coordinated by contracts and integrated operations, up from only 3% in 1980, and 17% in the early 1990s (Martinez, 1999).

[15] A precise definition of industrialized agriculture has yet to emerge. Welsh (1997) offers a conceptualization that is useful for this paper: "[t]he industrialized food system is characterized by highly concentrated production and processing sectors and coordination between stages of production via vertical coordination or contractual arrangements." For a general discussion about the industrialization of agriculture, see among others: Welsh (1996), Welsh (1997), Saxowsky and Duncan (1998), and Council on Food, Agricultural and Resource Economics (1994).

BOX 4.1. VERTICAL COORDINATION IN THE FOOD MARKETING SYSTEM AND ITS POTENTIAL ENVIRONMENTAL IMPLICATIONS

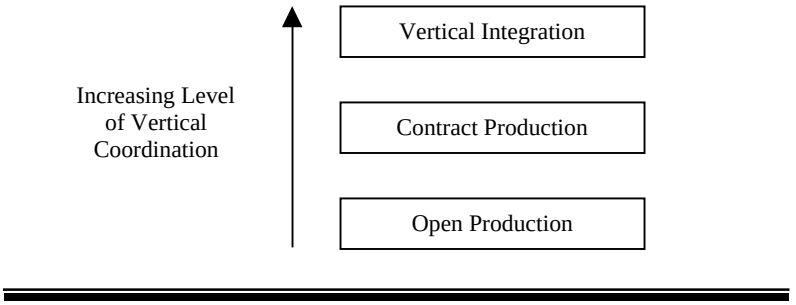
The food marketing system consists of a set of economic stages of production, which can be thought of as arranged vertically from the upstream production stage to the downstream retailing stage (from left to right in Figure 4.1.) The vertical coordination of these economic stages refers to all of the possible economic arrangements involving the transfer of resources between these stages (Martinez and Reed, 1996). More specifically, vertical coordination, includes all means of harmonizing vertically interdependent production and distribution activities, ranging from spot (cash) markets through various types of contracts to complete integration (Frank and Henderson, 1992). As is shown in Figure 4.2, firms in different economic stages coordinate the transfer of inputs and outputs in one of three basic ways: open production, contract production, or vertical integration, each of which represents an increasing level of vertical coordination.

Figure 4.1. Stages of the Food Marketing System



Traditionally, the food industry has operated in an open production system. In this system, fresh products (e.g., agricultural crops, livestock, fish) flow from their source of production into the processing sector through traditional commodity markets (some products—such as fresh produce—bypass this step), processors (or packers) distribute their manufactured products to retailers through wholesalers, and retailers sell the products to consumers. This open production system functions through reliance on the external coordination of the industries to guide food products from producers to consumers. As explained by Barkema (1993), in a system based on external coordination, the exchange of information and goods between adjacent stages of the food market occurs outside any one firm. External coordination works through price signals and a well-defined system of grades and standards that classifies food products. Prices link consumers to retailers, retailers to wholesalers, wholesalers to processors, and processors to producers. Prices, in turn, correlate closely with grades and standards, rewarding producers with higher prices for higher-grade products and penalizing them with lower prices for lower-grade products (Barkema, 1993). Examples of open production include farmers selling their wheat to the local grain elevator at the posted price or supermarkets selling their goods to consumers (Martinez and Reed, 1996).

Figure 4.2. Vertical Coordination



BOX 4.1. (continued)

Participants in the food marketing system increasingly are moving away from reliance on open production and becoming more vertically coordinated, either through contract production or vertical integration. Contract production occurs when commitments to sell a good to another stage are made prior to completing the good's production. Contract production, in other words, is a type of forward marketing in which one firm agrees to deliver a product to another firm prior to its completion (Martinez and Reed, 1996). Contracts may specify prices, markets, quantities, and qualities in advance of sale (Kohls and Uhl, 1998). A common type of contractual arrangement in the food marketing system is between producers and processors,* though they are also prevalent at other stages of the system.

There are a number of reasons that food marketing companies choose higher levels of vertical coordination. For one, as a firm moves along the continuum from open production to vertical integration, it is able to consolidate its overall control of its operations. Specifically, as empirical analysis by Frank and Henderson (1992) indicates, firms choosing increasing levels of vertical coordination enhance their ability to manage transaction costs, including factors related to uncertainty, input supplier concentration, asset specificity, and internalization of costs. A second important reason food marketing companies are turning to contract production and vertical integration is in response to an increasingly discriminating consumer with more specialized food consumption preferences. While an open production system works well for the production, promotion, and sale of relatively standardized products for mass markets, consumers are increasingly demanding specialized products forming niche markets (Kinsey, 1994; Barkema, 1994), which are more efficiently produced by firms engaged in contract production or firms that are vertically integrated. (The impact of changing consumer preferences is discussed in greater detail in the downstream environmental impacts section.)

Movement away from open production toward contract production and vertical integration implies that firms at one stage of production exert more control over the quality of output at other stages of production (Martinez and Reed, 1996). This control extends into the environmental realm, providing foodservice and food retail companies an opportunity to positively impact upstream environmental performance through changes in their own operations. Successful environmental management of their own operations not only limits their own adverse effects on the environment, but may have collateral benefits as well. Due to the recent trends of consolidation and increased market concentration, competitors will be under pressure to respond or face criticism for not operating with similar environmental performance improvements. This pressure, in turn, could have a "snowball effect" throughout the industry, affecting both other retailers and upstream companies, with a potential to spark significant environmental gain.

*There are two general types of contracts between producers and processors—marketing contracts and production contracts. Marketing contracts require a farmer to sell his or her product to a particular processor or intermediary firm (contractor), but allows the farmer to make all managerial and production decisions. Production contracts, in contrast, specify that farmers adhere to certain production practices determined by the contractor. More specifically, if a production contract requires that farmers adhere to certain production standards, but the contractor does not provide any tangible goods (such as inputs) to use in the production, the contract is termed a production management contract. If a production contract requires the contractor to provide an input, it is termed a resource-providing contract. See Welsh (1997) and Lipton, et al. (1998).

This is an important trend since some of the food industries adopting higher levels of vertical coordination also have significant environmental impacts. Moreover, the structure of these arrangements provides opportunities to improve environmental performance on a large scale. For instance, consider chicken and hog production, which are now largely done through contracts and integration. Most production contracts require growers to comply with all federal, state, and local regulations in the construction and

operation of their facilities and in the disposal of dead animals, but, presently, rarely include clauses that directly address environmental or nutrient management issues. Yet, at the same time, large contractors generally employ engineers and others to train farm operators, to keep records, and to provide manure management services on both company-owned and contract growers' farms. As a result, contractors are in a position to incorporate environmental clauses in contracts and offer support services to growers who otherwise could not afford such services on their own (Martin and Zering, 1997).

With respect to vertically integrated manufacturers, moreover, there is an important reputational capital associated with large companies (e.g., Tyson, Perdue) which provides incentives for them to work closely with growers to manage environmental issues associated with the production process (Martin and Zering, 1997). This shift of decision-making authority to the manufacturer bodes well for the ability of retailers to leverage their influence on the environmental aspects of food production, since both foodservice operators and food retailers generally have more direct relations and sway with manufacturers than with growers. (Examples are discussed later in this section.)

Another important trend is the recent collaboration between the foodservice and food retail industries and the wholesaling and manufacturing industries to improve the efficiency of their supply systems. These efforts began in 1993 when traditional format supermarkets and manufacturers sponsored the development of what is collectively referred to as Efficient Consumer Response (ECR), an initiative with the objective to streamline and automate the distribution system from the production line to the grocery checkout line, with a broader goal of suppliers and retailers working together to bring better value to the customer (Larson, 1997). In large measure, the ECR initiative was a response to the growth of competing nontraditional retailers, particularly supercenters, which were gaining market share through their logistical advantages (Kahn and McAlister, 1997).

The focus of ECR has been the implementation of information management technology to optimize the logistics of moving products from the manufacturer to the consumer (Soucie, 1997). ECR has four primary strategies—efficient product assortment, efficient product replenishment, efficient product promotion, and efficient product

introduction[16]—each of which depends on electronic/computer technologies (e.g., point-of-sale scanning, electronic transmission of information, bar codes for case and pallet identification) (Marcus, et al., 1997). At the time ECR was introduced, the total potential savings from its utilization was estimated to be $30 billion (Kurt Salmon Associates, 1993). This expected gain, in addition to early successes of the ECR, prompted the foodservice industry to respond with a parallel initiative known as Efficient Foodservice Response (EFR). Based on the same general principles and relying on similar information technologies, EFR has five main strategies: equitable alliances, supply chain demand forecasting, electronic commerce, logistics optimization, and foodservice category management. The potential savings from the implementation of EFR have been estimated at $14.3 billion (FDI, 1997).

In addition to cost savings, ECR and EFR provide mechanisms to increase the efficiency of communication among the components of the food marketing system. This improved coordination, in part, is aimed at helping food companies provide food products precisely matched to consumer demand. As consumer demand for environmentally friendly products (e.g., organic foods, recycled-content packaging) continues to grow, ECR and EFR should enable the food industry to quickly respond and design new products that reflect these consumer preferences. Furthermore, with each industry closely examining its supply chains, it is an opportune time to consider ways to reduce the environmental impacts of moving products from one stage of the system to the next.

Collectively, these trends signal an increased ability for foodservice and food retail companies to influence upstream environmental behavior. Fewer, but larger and more powerful, companies control the production, manufacturing, and movement of food products through the system. Consequently, decisions made by retailers can potentially

[16] Efficient product assortment pertains to the utilization of shelf and store space and includes factors such as the length of time a grocery item remains in the store prior to sale, the size of stock rooms, shelf space allocation based on product through-put data, category management versus pushing of units, and high impact merchandising. Efficient product replenishment refers to how effectively a store turns its inventory and includes use of information technology to improve inventory management with an objective of "just-in-time" delivery. Efficient product promotion refers to finding cost-savings in the promotion of products to trade (deals) and to customers (advertising and coupons). Efficient product introduction refers to streamlining the development of new products, and includes more accurately reflecting consumer preferences, reducing the number of products introduced, highlighting more meaningful attributes, and reducing slotting fees. See Larson (1997) and Soucie (1997).

have a widespread impact on the overall environmental performance of the food marketing system.

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The balance of this section is divided into two parts. The first discusses some of the key opportunities for foodservice and food retail operators to harness environmental gain through their supply chains. The second part of the section considers three environmental issues occurring upstream from retailing in the food marketing system—pesticides, animal waste management, and food safety—and illustrates some ways in which the foodservice and food retail industries can have an impact on these environmental concerns.

Vertically Integrated Companies

Many foodservice and food retail companies are vertically integrated and perform functions in the food marketing system other than retailing. With the control that comes from ownership, these companies can make unilateral decisions to improve environmental performance in these upstream operations. A couple of examples are discussed below.

Self-Distribution

Food retail operators are normally supplied through one of three distribution channels—self-distribution, manufacturer direct store delivery, and wholesaler supply—the latter two of which are discussed later in this section. The self-distribution channel represents the situation when distribution and retailing are under the control of the same firm. In this channel, food products bypass the wholesaling component of the food marketing system entirely, and flow from the manufacturer (or in the case of fresh produce, from the grower or packer) directly into a distribution system owned and operated by the retailer (ECR Performance Measures Operating Committee, 1994). The self-distribution channel is a form of vertical integration in which food retail companies own and operate their own warehousing and distribution services.

Self-distribution by grocery retailers has become standard in the industry with most stores at least somewhat vertically integrated into warehousing and distribution.[17] Grocery retailers choose to vertically integrate to both enhance the prospects of greater operational efficiency and to gain strategic advantages over competitors (Connor, 1997). With just a few exceptions, the top 50 food retailers (in terms of sales) are fully integrated into grocery wholesaling, and the leading grocery companies have considerable investments in warehouses, trucks, and trailers. Alberston's, for instance, operates 15 distribution centers with a total warehousing capacity of over 7.5 million square feet. These distribution centers supply all of the company's stores, accounting for 75% of all their products purchased (Albertson's, Inc., 1999). Full backward integration into grocery wholesaling is the norm for retailers with annual sales over $3 billion, with 76% of their operations supplied with products from their warehouses. Companies with annual sales between $1 to $3 billion and $500 million to $1 billion also rely heavily on company-owned warehousing and distribution, accounting for 60.8% and 51.6% of their supplies, respectively (FMI, 1997b).

A variation on this type of backward vertical integration done by individual grocery companies is the retailer cooperative in which a group of retailers collectively own the wholesaling operations serving them. Wakefern Food Corporation and Associated Wholesale Grocers, Inc., the fifth and eighth largest grocery wholesalers, respectively, are examples of retailer cooperatives (Belonax, 1999). Additionally, the large number of grocery retailers engaged in self-distribution reflects wholesale companies that have forward vertically integrated into retailing operations. The two largest grocery wholesalers in terms of 1998 sales, Super Valu and Fleming, for example, have each made significant investments in retailing, representing the 16th and 21st largest grocery store chains in 1998 sales, respectively (Chain Store Guide Information Services, 1999). The emergence of wholesale clubs illustrates another example of vertical

[17] Two basic types of integration occur in grocery wholesaling: full integration and "partial" or "tapered" integration. Full integration has been defined as sole ownership of warehousing for produce, other refrigerated foods, and all other groceries except perhaps frozen foods, housewares, health and beauty aids, and candy-magazine racks. "Partial" or "tapered" integration has been defined as ownership of substantial warehouse capacity (at least 100,000 ft^2) together with purchases of groceries from merchant wholesalers. Tapered integration is a less frequently used strategy, most common among some large convenience-store chains and supermarket chains with 1990 sales of between $400 and $800 million dollars. See Connor (1997).

integration in the food retail industry, with companies such as Costco and Sam's extending their warehousing and distribution operations into retail formats.

Since the warehousing and distribution functions are often under the direct control of food retail operators, vertically integrated companies have leverage to affect the environmental impacts of these upstream activities. The most significant environmental concern arising from these operations is air pollution and, more specifically, the concentration of air pollutants around supermarket distribution centers. This problem arises in particular for grocery retailers with fleets of diesel-fueled trucks. Diesel emissions have been cited as a contributor to ground-level ozone (smog), which is associated with many adverse health and welfare effects, including respiratory illness, environmental damage, and visibility problems (haze) (EPA, 1996).

One recent study evaluating diesel exhaust in supermarket distribution centers in California found that both workers and local residents are exposed to potentially unsafe levels of particulate emissions. Around one facility, the study concluded that exposures posed a risk of lung cancer to local residents beyond levels requiring warnings under California's anti-toxic law (Solomon, et al., 1998). These results prompted the State of California and environmental groups to file a lawsuit against four of the state's largest grocery chains: Von's, Ralph's Grocery, Lucky Stores, and Stater Bros (Cone, 1998).[18] Some grocery retailers have recognized the importance of this environmental problem and responded with efforts to curb diesel emissions. H.E.B. Grocery, for instance, has made efforts to reduce its diesel consumption and emissions by loading trucks for multiple stops and back-hauling recyclables from stores after deliveries (H.E.B. Grocery, 2000a).

Of course, air pollution from truck emissions is not limited to that in and around distribution centers, but extends to the emissions of trucks during distribution. Aggregate emissions data from grocery distribution trucks are not available, but mobile sources are well chronicled as important sources of the air emissions that contribute to both local and regional air pollution problems (EPA, 1998a). Some grocery retailers have begun to address this issue. Raley's Grocery, a chain based in northern California, for example, has

[18] The lawsuit is still pending. Following denial of a motion to dismiss, the trial was scheduled to begin in January 2000, though settlement discussions are ongoing. Personal Communication with Gail Ruderman-Feuer (1999).

already converted 20% of its fleet to natural gas trucks, reducing the company's consumption of diesel fuel by approximately 100,000 gallons per year and resulting in a NO_x reduction of up to 40 tons during the first seven years of operations. H.E.B. Grocery is also in the process of converting its fleet of trucks serving the Houston area to natural gas. To date, ten of the company's 54 trucks now run on natural gas, and the company intends to convert the rest of its fleet following in-use performance evaluations (Solomon, et al., 1998).

Other potential environmental issues stemming from warehousing and distribution operations include noise pollution and traffic congestion. Though these issues are of relatively lesser significance than diesel exhaust, they still represent important quality of life concerns that should be recognized. More empirical analysis, however, is necessary before it is possible to determine the full contribution of grocery warehousing and distribution to noise pollution and traffic congestion.

Self-Manufacturing

Another type of vertical integration in the food retail industry is self-manufacturing. Many of the large, national chain grocery companies have moved upstream into manufacturing, operating many different kinds of facilities, including bakeries, dairy processing facilities, beverage facilities (e.g., production, bottling), and many other types of food processing operations. Food retail companies operating their own manufacturing facilities also tend to operate their own warehousing and distribution, thus performing most of the functions of the food marketing system themselves, and in this way greatly reducing their transaction costs and increasing their overall operational efficiency.

A good example of the diversity of food manufacturing done by large grocery retailers is that of Safeway, the second largest grocery chain in the country. At year-end 1998, Safeway operated 30 manufacturing and processing facilities in the United States (and 13 additional facilities in Canada), including eight milk plants, six bread baking plants, five ice cream plants, four soft drink bottling plants, and numerous other general food processing and packaging facilities.[19] About half of Safeway's private label

[19] These facilities include three general food processing plants, two fruit and vegetable processing plants, one cheese and meat packaging plant, and one pet food plant.

merchandise is manufactured in company-owned facilities (Safeway Inc., 1999). Kroger has also made significant investments upstream into food manufacturing, operating ten dairy facilities, seven grocery product facilities (e.g., processed cheese, peanut butter, coffee, spaghetti sauce), six bakery/deli facilities, and three beverage facilities (e.g., soft drinks, fruit juices, hot pack tea) (Kroger, 2000). Self-manufacturing is not limited solely to the top-tier food retail companies. Pay Less Super Markets (based in Anderson, Indiana), for instance, operates two central bakery facilities, each supplying four of the company's eight stores (Progressive Grocer, 1997b). In large measure, grocery retailers have turned to self-manufacturing to produce private label products and, more specifically, those that are store brand. As an alternative to contracting with a third-party manufacturer, food retail operators can produce, distribute, and market the store brand products themselves, thereby reducing costs and increasing profit margins.

Despite examples such as Pay Less Super Markets, most self-manufacturing is done by the largest, national chain grocery retailers. However, the number of stores served by self-manufacturing grocery companies and the local market share of these stores suggests that they are important to consider in an analysis of upstream environmental impacts. Moreover, many of these retail-owned manufacturing and processing facilities are among the industry's largest.[20]

Similar to other goods-producing industries, food manufacturing facilities typically are subject to the environmental permitting requirements of federal environmental statutes such as the Clean Water Act and Clean Air Act, and the regulations of other relevant environmental laws (e.g., the Resources Conservation and Recovery Act). Emissions and wastes vary by type of food manufacturing and processing facility, and a full discussion of these differences is beyond the scope of this paper. Among the upstream environmental impacts that vertically integrated grocery retailers can leverage are the emission of VOCs and high-BOD water effluent from bakeries (EPA, 1998a; Carawan, 1996a), high water usage from dairy processing facilities (Carawan, 1996b), and toxic byproducts from meat packing plants (EPA, 1998b) and other company-owned packaging and processing facilities.

[20] The bakery facilities owned by Kroger, for example, collectively make the company the nation's seventh largest bakery (Kroger, 2000). The bread bakery owned by the H.E.B. Grocery has been the largest operating in the State of Texas for over 20 years (H.E.B. Grocery, 2000b).

Contracts

Contracts represent another vehicle that can be used to "green" the supply chain. As was described in Box 4.1, contractual arrangements represent an intermediate form of vertical coordination. Contracts are a ubiquitous part of the food marketing system and serve as a mechanism enabling companies to coordinate supply and demand. Among the important examples of contracting in the foodservice and food retail industries are agreements between a franchiser and individual restaurants, restaurant chains and food manufacturers, and food retailers and food manufacturers.

Franchising has been a key component of the expansion and success of commercial restaurants, particularly fast food outlets (Connor and Schiek, 1997). In many national restaurant chains organized through franchising, the parent firm acts more as a wholesaler than an owner, and has considerable control over the purchasing of supplies for individual stores (Shaffer, et al., 1998). By definition, local owners pay for the rights to use the store name, format, menu, recipes, and preparation practices (Connor and Schiek, 1997), all of which are largely controlled by the franchiser.

Contracts are also prevalent between large restaurant chains and food manufacturers. National restaurant chains have sizable influence on the manufacturing of the products they use and service. Food products specifically designed for the fast food industry, for example, are typically developed in a collaborative fashion between food processors and restaurant corporations. Subsequently, the products are manufactured and commonly sold to the restaurant company through a negotiated fixed-price contract (Marion, 1986), and distributed by foodservice distributors also specified by the restaurant company. The fast food industry, for instance, played a central role in the development of frozen potato products, providing a mass market, developing benchmark quality standards, and forcing the development of a frozen processed french fry product (Nagengast and Appleton, 1994). Moreover, because of their size, especially the national chains, these decisions by foodservice companies can have significant impacts on the processing and ultimately the production of products. When a large restaurant chain alters its menu, it creates significant changes in processed food markets, as hundreds or even thousands of individual restaurants demand a different set of products (Connor and Schiek, 1997).

Contractual arrangements are also common between food retailers and food manufacturers. For one, agreements are reached regarding the promotion and shelf space allotted to manufacturer-branded products. Though driven by consumer demand, food retailers largely determine whether or not to carry specific products and how much shelf space to allocate to the products they do carry (Marion, 1998). Food manufacturers, of course, have a role in these decisions as well, most conspicuously through advertising. Moreover, and less transparent to the customer, are the product placement fees, often referred to as slotting fees, that manufacturers pay food retailers for preferential shelf space, particularly to bolster the sales of newly introduced products. Slotting fees are typically negotiated between food retailers and manufacturers, and have been estimated to total about $9 billion annually, with a common fee about $5,000 per item, per store (Associated Press, 1999).

Additionally, food retailers generally contract with food manufacturers for the production of private label products with the store's own name, so-called store brand products. (Vertically integrated food retailers produce some of their own store brand products.) Contracts normally specify the quality guidelines for each store brand product, with the food retailer in a strong position to dictate these guidelines. This is particularly the case in light of the competitiveness of the private label manufacturing industry and the fact that most retailers typically contract with more than one food manufacturer (Connor and Schiek, 1997).

Another type of contractual arrangement between food retailers and food manufacturers is manufacturer direct store delivery (DSD). DSD is defined as the delivery of merchandise from a manufacturer directly to a retail store (or restaurant), bypassing warehouse facilities (FMI, 1999). As grocery store chains have grown larger and more concentrated, food processors have found it advantageous to negotiate contracts with and distribute directly to large customers. DSD is increasingly popular among large food manufacturers that offer broad assortments of products; these manufacturers would rather work directly with large retailers and employ brokers to handle sales and some distribution functions for smaller accounts (Connor and Schiek, 1997). Major categories of food products supplied to foodservice and food retail operations through DSD include: soft drinks, beer, bread, fresh baked goods, dairy products, and fragile items that require

careful handling, such as potato chips and some gourmet products (FDI, 1997; FMI, 1999). According to a recent survey by the Food Marketing Institute (1999), a median of 27% of retail sales were supplied by DSD in 1998, down from 30% in 1997 (FMI, 1998a). DSD is less common in the foodservice sector; Food Distributors International (1997) found that, in 1997, only 12.7% ($14.4 billion) of manufacturer sales of foodservice products was delivered directly to foodservice operations. Since food retailers have the ultimate power to decide which products to put on their shelves, DSD contracts provide an opportunity to influence manufacturer behavior.

Though the dynamics of each type of contractual arrangement differ, in each situation the participating foodservice or food retail company is in an auspicious position to integrate environmental criteria into the agreement, or to take such criteria into account when choosing a contractor. In other words, a company can negotiate product specifications or process guidelines with the environmental implications in mind. Whether through mandating that a franchisee use recycled-content packaging, requiring food manufacturers to use organic ingredients, demanding that manufacturers of private label products maintain the highest food safety standards, reducing slotting fees for environmentally friendly products, or providing incentives to manufacturers that do their own distribution to convert to less environmentally intensive modes of transport, foodservice and food retail companies can use their positions to promote positive upstream environmental gain. Moreover, due to the pervasiveness of contractual arrangements, they represent a potent lever for foodservice and food retail companies to use to promote improved upstream environmental performance.

Strategic Alliances

Strategic alliances, also known as vertical alliances, are another prevalent piece of the supply chain. An informal collaboration between firms based on trust and involving transfers or sharing of assets, strategic alliances serve a similar function as contracts. Buyers and sellers work collaboratively to reduce their risk and transaction costs, but maintain separate operations and independent identities (Kohls and Uhl, 1998; Sporleder, 1992). An advantage of strategic alliances is that they offer many of the same benefits (e.g., improved operational efficiency) of other forms of vertical coordination without the equivalent investment of human and financial resources (Whipple and Frankel, 1999).

Common examples of strategic alliances in the food marketing system are those between foodservice companies and foodservice distributors. This type of strategic alliance is particularly widespread among fast food companies and specialized foodservice distributors. Rather than deal with different, nonspecialized distributors in each local and regional market area, many large fast food chains have developed distribution agreements with fewer, specialized foodservice wholesalers (Marion, 1986). McDonald's, for instance, has developed strategic alliances with several foodservice distributors—including Martin-Brower, Golden State Foods Corporation, and Perlman-Rocque Co.—which serve as the sole suppliers of certain products for McDonald's restaurants in given geographical areas (Martinez and Reed, 1996; ID Magazine Online, 2000). Other examples include Applebee's, Olive Garden, and TGI Fridays, each of which has formed a strategic alliance with Ameriserve Food Distribution, and King Provision Corporation, which is the sole supplier of some 700 to 800 Burger King restaurants (ID Magazine Online, 2000). Thus, although these companies do not own their own distribution or warehouse facilities, they are able through these strategic alliances to garner many of the same benefits that accrue to vertically integrated firms.

Foodservice companies that have entered into these types of strategic alliances are in strong positions to influence which products their foodservice distributors supply, including their environmental attributes. Consider the case of McDonald's. Martin-Brower is a $2.9 billion company whose sole client is McDonald's, serving over 7,000 individual establishments in the United States, Canada, and South America (ID Magazine Online, 2000). Consequently, when McDonald's initiated its "buy-recycled" program (The company currently spends $350 million annually for a variety of recycled-content products, including dining trays, construction materials, chairs, tables, napkins and other paper products, packaging.) (EPA, 1999c), Martin-Brower had little choice but to work with new suppliers to ensure that McDonald's received the products it wanted. Complicated by McDonald's unwillingness to pay a price premium (Business for Social Responsibility, 1999), failure of Martin-Brower to do so would have threatened the strategic alliance. An ancillary effect of McDonald's action, and its ability through its strategic alliance to ensure the supply of the products it sought, is that other foodservice distribution companies with an interest in competing for future McDonald's business, will

have to match if not exceed Martin-Brower's ability to work with suppliers of recycled-content products. When this is expanded to the industry level, a larger market for recycled-content products may begin to develop, thereby furthering the positive upstream environmental impact of McDonald's effort.

Wholesaler Supply Channel

A final important part of the supply chain serving the foodservice and food retail industries is the wholesaler supply channel. Despite the high levels of vertical coordination that exist throughout the foodservice and food retail industries, many foodservice and food retail operations still rely on traditional distribution channels for the supply of the ingredients they use or the products they sell. This reliance does not mean, however, that these companies are unable to influence upstream environmental behavior.

Foodservice operators and food retailers that do not obtain their products through either self-distribution or manufacturer DSD, are supplied through the wholesaler supply channel. This channel is the conventional means by which food products move through the food marketing system. In the wholesaler supply channel, manufacturing (or packing), distribution, and retailing are performed by three separate firms; products flow from manufacturers to distribution centers operated by wholesalers, and then on to individual foodservice and food retail establishments (ECR Performance Measures Operating Committee, 1994). Thus, within this distribution channel, wholesalers are the conduit between the food manufacturer (and sometimes the producer) and the foodservice and food retail operator. Nonspecialized wholesaling operations that serve the foodservice industry are generally referred to as broadline foodservice distributors,[21] whereas those that serve the food retail industry are known as grocery wholesalers. Table 4.1 lists the 1998 sales of the largest companies of each type.

[21] There are two basic types of foodservice distributors: broadliners that carry a wide assortment of food and nonfood products and specialists in specific product categories or market segments. See Belonax (1999).

TABLE 4.1. LARGEST GROCERY WHOLESALERS AND BROADLINE FOODSERVICE DISTRIBUTORS, 1998 SALES

Rank	*Broadline Foodservice Distributors*	*Dollars (millions)*	*Grocery Wholesalers*	*Dollars (millions)*
1	Sysco, Co.	16,152.5	Super Valu Stores, Inc.	11,846.0
2	Alliant Foodservice, Co.	6,100.0	Fleming Companies, Inc.	11,476.0
3	U.S. Foodservice	5,800.0	McLane Co., Inc.	10,350.0
4	Pya/Monarch, Inc.	2,700.0	C and S Wholesale Grocers	5,100.0
5	Gordon Food Service	1,800.0	Wakefern Food Corporation	4,860.0
6	Performance Food Group	1,600.0	Nash-Finch Company	3,370.0
7	Food Services of America	1,098.0	Topco Associates	3,330.0
8	Shamrock Foods, Co.	820.0	Associated Wholesale Grocers (K.C.)	3,280.0
9	Reinhardt Foodservice, Inc.	604.0	Richfood Holdings	3,010.0
10	Ben E. Keith Foods	437.0	Core-Mark International	2,451.0

Does not reflect recent mergers and acquisitions.
Sources: ID Magazine Online (2000); Chain Store Guide Information Services (1999).

The foodservice industry relies significantly on the wholesaler supply channel for the products it uses. Food Distributors International (1997) found that, in 1997, $98.6 billion (87.3%) of the $113 billion total manufacturer sales of foodservice products was shipped to foodservice operators through foodservice distributors. Wholesaling to foodservice operations is increasingly done by large, national-scale companies such as Sysco Co., Alliant Foodservice, Co., and U.S. Foodservice, which offer extensive product lines (e.g., over 40,000 in the case of U.S. Foodservice) consisting of national, private label, and signature brand items for both commercial and noncommercial foodservice establishments (Krummert, et al., 1998).

Dissimilarly, food retailers receive a relatively small amount of the products they sell through the wholesaler supply channel. As was discussed previously, most grocery retailers, particularly national chains, do their own warehousing and distribution or are supplied through DSD. A 1997 survey conducted by the Food Marketing Institute (1997b) found that for the 199 companies responding, only an average of 7.4% of their products were supplied by wholesalers. Grocery wholesalers tend to serve food retail establishments that are too small to operate their own warehouses, namely, small grocery chains that operate less than 30 or 40 supermarkets or nonchain grocers (Connor, 1997).

The opportunity for foodservice (both commercial and noncommercial) and food retail operators to influence upstream environmental behavior through the wholesaler

supply channel is potentially considerable.[22] Individual restaurants and stores have the ultimate authority to determine which products they offer to their customers. This decision is based on a number of factors such as cost, quality, availability, and consumer demand. It is within an individual operator's discretion to expand these decisions to include environmental criteria through consideration of the environmental impacts of the production, manufacturing, and distribution of the items they use or sell. This type of decision-making (e.g., using organic ingredients in meal preparation, shelving “green” products), may serve to broaden the market for environmentally friendly products. At the same time, it may send signals upstream through the food marketing system, thereby encouraging the food industries to reduce the environmental impacts associated with their operations.

Retailers Influence on Upstream Environmental Issues—Three Examples

The discussion above illustrates that there are a wide variety of opportunities for foodservice and food retail operators to affect upstream environmental issues through the supply chain. The balance of this section highlights three issues—pesticides, animal waste, and food safety—and considers more explicitly the potential ways that foodservice and food retail companies can contribute to the mitigation of their impacts. While some may perceive these issues as beyond the purview of foodservice and food retail, to fully account for the environmental implications of these industries it is necessary to include them in this analysis. In fact, some multinational grocery retailers, including those with holdings in the United States, have already begun to recognize the importance of this broader understanding of their environmental impacts. Royal Ahold, based in the Netherlands and owner of five U.S.-based grocery store chains (Stop and Shop, Giant-Carlisle, Tops, Giant-Landover, and Bi-Lo), has directly addressed a number of upstream environmental issues including pesticides and packaging (Ahold, 1998). Sainsbury, based in the United Kingdom and owner of a controlling interest of Shaw's Supermarkets in the

[22] The ability of small, nonchain foodservice and food retail operators to "green" their supply chains by integrating environmental considerations into purchasing decisions is recognizably difficult. The difficulty lies primarily in the nature of their relationships with the wholesalers on whom they depend heavily for the supply of the products that they use and sell. Unlike their large, national chain counterparts, these operators do not have the same purchasing power or ability to exert leverage over their suppliers through either contractual arrangements or strategic alliances. In fact, the opposite is often the case, with wholesalers

United States, also has recognized the company's effects on the environment include those occurring upstream (J Sainsbury plc., 1998). The discussion that follows is not exhaustive, but simply illustrative of the types of options retailers have to use their position and leverage in the food marketing system to benefit environmental quality.

Pesticides

Pesticides are defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating pests (e.g., insects, mice and other animals, unwanted plants (weeds), fungi, or microorganisms like bacteria and viruses) (EPA, 1999b). In 1995, an estimated 565 million pounds of pesticides were applied to major field crops, fruits, and vegetables, an increase of 13% from 1990. Conventional pesticides collectively constituted about 77.5% of this total, with herbicides accounting for 57.2%, insecticides for 12.3%, and fungicides for 7.9% (USDA/ERS, 1997). Three issues are of particular concern with respect to pesticides: residues on food, farmworker exposure, and contamination of water.

Pesticide residues on food are an important concern primarily due to the potential carcinogenic risks that they pose. Typically, pesticides occur in food from agricultural residues that remain on foodstuffs, from chemicals used in storage facilities, or from water used in food preparation (National Research Council, 1996). With the exception of meat, poultry, and certain egg products, for which the Food Safety and Inspection Service of the USDA is responsible, the FDA has the primary responsibility for enforcing the EPA-set pesticide tolerance allowances on food products (raw and processed food, whether domestically produced or imported, and animal feeds).

In 1998, the FDA regulatory monitoring program (food samples taken soon after production) found that pesticide residues in food were generally well below EPA tolerances; no residues were found in 64.9% of domestic surveillance and 68.1% of import surveillance samples. Only 0.8% of domestic and 3.0% of import surveillance samples had residue levels that were “violative.”[23] The FDA also administers a supplementary analysis of pesticide residues on food, the Total Diet Study, which

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having sizeable influence over the products they warehouse and distribute, and, thus indirectly, over the environmental character of their product lines.

[23] Violative is defined as "a residue which exceeds a tolerance or a residue at a level of regulatory significance for which no tolerance has been established in the sampled food" (FDA, 1998).

specifically monitors foods prepared for consumption (food samples taken from grocery stores). In 1998, pesticide residue levels were found to be well below regulatory standards (FDA, 1998). Despite the low level of instances when pesticide residues have been found to exceed the EPA-set tolerance levels, surveys have repeatedly indicated this issue is a significant concern for consumers (Ott, et al., 1991). A recent survey by the Food Marketing Institute (1997a) found that about 65% of respondents considered pesticide/herbicide residues to be a "serious health risk."

Worker exposure to pesticides is another potentially significant risk to human health. Estimates indicate that from 10,000 to 20,000 farmworkers suffer from acute pesticide poisonings each year in the United States (Blondell, 1997; Reigart and Roberts, 1999). Exposure can occur from a variety of activities such as mixing or applying pesticides, during the planting, weeding, thinning, irrigating, pruning, and harvesting of crops, or from living in the midst of treated fields (Reeves, et al., 1999). In 1992, the EPA developed a Worker Protection Standard aimed at providing safeguards for agricultural workers and pesticide handlers that requires protection during spraying, restricted-entry intervals (waiting periods after application), provision of personal protective equipment, notification of workers, training, and access to labeling and site-specific information (EPA, 1999a).

An additional concern that arises from agricultural pesticide application is the contamination of water resources, including both surface water and groundwater. Studies have detected pesticides in surface waters in all regions of the country, with herbicides more commonly detected than insecticides (this finding is consistent with the fact that more herbicides are used) (USGS, 1997). Though concentrations have usually been found to be within acceptable limits, studies have shown that concentrations of pesticides do at times exceed EPA-set maximum contaminant levels and lifetime health-advisory levels (Smith, et al., 1991). Pesticides are also a concern in groundwater. Pesticides generally are detected at low concentrations in groundwater, but nationally, approximately 2% of wells sampled by multi-state studies have concentrations that exceed regulatory limits (USGS, 1995).

Although neither the foodservice nor food retail industry is directly responsible for the use of pesticides, each can take steps to curtail their use and thus reduce the

potential health and ecological risks they pose. With respect to the foodservice industry, for example, the approach with the most potential impact would be for operators to increase their use of organic ingredients in their meals. Some evidence suggests that steps in this direction are underway. According to a 1996 survey by the National Restaurant Association, about 57% of restaurants with per person dinner checks of $25 or more, and 29% of restaurants with prices in the $15 to $24 range offer organic items on their menus (Natural Foods Merchandiser, 1996). Another example of the integration of organic foods in foodservice offerings is that of Swissair, which has plans by 2000 for 90% of all its meals served to be organic (Gordon, 1999). The use of organic ingredients and the serving of organic foods are also becoming part of the offerings of the noncommercial market segment of the foodservice industry. The Berkeley, California school system, for instance, recently announced its intention to switch to pesticide-free, herbicide-free, and synthetic-fertilizer-free food in its foodservice to the district's 9,400 students (Gemperlein, 1999).

Other steps that foodservice operators can take include sourcing from suppliers that have transparent and stringent worker protection programs in place. To the extent possible, this should include international suppliers as well. Large, national chain restaurants supplied by either contracted or strategically aligned foodservice distributors, can insist that these wholesalers identify and distribute products that are pesticide-free. Similarly, foodservice operators with considerable influence with manufacturers—such as fast food operators that negotiate fixed-price contracts with food manufacturers—can work collaboratively to develop and use food ingredients that are not produced using unsafe levels of pesticides.

With respect to the food retail industry, the simplest measure operators can take to reduce the use of pesticides is to provide a large selection of organic and chemical-free items on their shelves. Many food retailers have already taken steps in this direction. Sixty-five percent of traditional supermarkets now carry natural and/or organic foods (Kinsey, et al., 1996). Many of the larger national chains have also expanded the natural foods offered in their stores. Albertson's, A&P, and Publix, for instance, have all indicated that they will stock processed organic foods—including frozen entrees, sauces, dressings, tortilla chips, pretzels, and syrups—in addition to organic produce items

(Kaufman, 1998a). In addition to carrying organic products, food retailers can carry produce that has been cultivated using Integrated Crop Management (ICM) techniques which reduce pesticide and fertilizer use. Tops Markets, a subsidiary of Royal Ahold based in Buffalo, New York, for example, purchases more than half of its in-season produce from a local grower's cooperative in Eden, New York which uses ICM to lessen chemical inputs (Ahold, 1998).

Furthermore, self-manufacturing food retail companies can carry pesticide-free private label food products. For store brands, vertically integrated retailers can source from organic farms or from food producers and processors that have made efforts to reduce pesticide usage. In terms of other private label products, food retailers that contract out manufacturing or use a product supplied by a wholesaler, can shop around for labels that have pesticide-free products. As a final example, food retailers can discourage pesticide use by giving organic products preferential locations on their shelves. Such a move may require waiving or reducing slotting fees, but will help to raise the competitiveness of these products.

Animal Waste

The waste from animal agriculture has increasingly been identified as posing important environmental quality concerns. There are approximately 450,000 animal feeding operations (AFOs) nationwide, which have been defined as operations that congregate animals, feed, manure and urine, dead animals, and production operations on a small land area (USDA/EPA, 1999). AFOs confine a U.S. population of animals in livestock production that includes over 77 million cattle and calves, about 60 million swine, and almost 1 billion broilers. The total annual waste from this livestock has been estimated at 112 million tons (dry matter), excluding used bed (e.g., spilled feed, dead animals) (Copeland and Zinn, 1998).

AFOs have numerous environmental implications. Animal waste runoff can impair surface water and groundwater through the introduction of pollutants, including nutrients (e.g., nitrogen, phosphorous), organic matter, sediments, pathogens (e.g., bacteria, viruses), heavy metals, hormones, antibiotics, and ammonia. Typically, these pollutants are transported by rainwater, snowmelt, or irrigation water through or over land surfaces. Ultimately, they are either deposited in rivers, lakes, or coastal waters, or

leached into groundwater (GAO, 1999a). Excessive nutrients in water, for instance, may result in or contribute to eutrophication, anoxia (e.g., low levels of dissolved oxygen), and toxic algal blooms, which may be harmful to human health, and may contribute to outbreaks of microbes such as *Pfiesteria piscicida* (USDA/EPA, 1999). These potential risks to human and ecological health can be particularly relevant following emergencies, such as major flooding events, which can overwhelm standard nutrient and waste management systems.

Another environmental problem associated with animal wastes is the airborne transport and deposition of pollutants. A 1995 study in North Carolina found that ammonia emissions from swine operations, located mainly in the south coastal part of the state, accounted for more than 50% of the state's total nitrogen oxides-nitrogen emissions from either point sources or highway mobile sources (Aneja, et al., 1998). Ammonia, as well as other gases (e.g., hydrogen sulfide, methane) and organic compounds, also contribute to odor problems produced during the decomposition of manure (Copeland and Zinn, 1998).

Most agricultural activities are considered to be nonpoint sources of pollution under the Clean Water Act and, thus, are not required to obtain a NPDES permit. Concentrated animal feeding operations (CAFOs), however, are an exception and are treated in a similar manner to other industrial sources of pollution, though the EPA has estimated that only about 1.5% of CAFOs meet the thresholds triggering permitting requirements (must be at least 1,000 animal units; an animal unit is about one cow). Moreover, regulating these operations has not until recently been a high priority for the EPA (Copeland and Zinn, 1998). In March 1999, the agency in coordination with the USDA announced a Unified National Strategy for Animal Feeding Operations, which, among other mandates, would require an estimated 15,000-20,000 animal feeding operations (the largest in the livestock industry) to develop comprehensive nutrient management plans and comply with Clean Water Act requirements as part of their permits. The remaining operations would be encouraged to develop voluntary nutrient management plans (USDA/EPA, 1999).

Though the environmental concerns associated with animal waste occur during the production process, the magnitude of vertical integration and contract production in

the animal foods industry means that the ability to influence environmental behavior rests less with producers than with manufacturers. Since retailers generally have more sway with manufacturers than producers, the structure of the animal foods industry suggests that retailers are in a position to use their influence to encourage improved environmental management in the production process. For example, Wendy's contracts with Perdue Farms for the production and supply of its chicken nugget product (DeGross, 1998). Similar to other poultry companies, Perdue controls (through vertical integration and production contracts) every phase of the production process for its products, including feeding, slaughtering, and packaging (Silverstein, 1999). Through its contract with Perdue, Wendy's is in a position to reduce the environmental impacts associated with animal waste by insisting that Perdue meet certain environmental management requirements, with the ultimate option of choosing an alternative supplier in case Perdue is unwilling to acquiesce to these requests.

Food retailers can wield similar power in their decisions regarding whether or not to stock animal food products. The decisions about which brand of poultry products to carry is generally driven by price and customer preferences (Degross, 1998), but it is within a food retailer’s discretion to add environmental criteria to their decision-making process. Alternatively, grocery retailers can reduce slotting fees or provide preferential shelf space for poultry and other meat products that were produced with relatively less impact on the environment. These types of decisions would send signals to the animal foods industry that the environmental impacts of their operations are important.

Food Safety

As was discussed in the direct environmental impacts section, the contamination of food from biological pathogens can stem from mishandling at individual restaurants and grocery stores. Pathogens, however, can also taint food at other stages of the food marketing system (e.g., use of unclean irrigation water during production, mishandling during initial processing, use of dirty trucks during distribution) (Tauxe, 1997). Moreover, there are other potentially important food safety issues occurring upstream from foodservice and food retail establishments that deserve mention.

One emerging concern regards the antibiotics used in agriculture to treat and prevent diseases in animals and food plants and as a feed additive to improve growth

rates in animals. The use of these antibiotics has been linked to the emergence of antibiotic-resistant strains of disease-causing bacteria (e.g., *Salmonella*, *Campylobacter*, and *E. Coli*) (GAO, 1999b; Brown, 1999). Researchers believe that the resistant strains develop in the animals and then pass to humans through food or through direct contact with animals or animal waste. Accurately determining the risk of antibiotics to food safety (and whether this risk outweighs the benefits of their use) is difficult, particularly due to a lack of comprehensive estimates as to the extent to which antibiotic-resistant strains have resulted in illness and death (GAO, 1999b).

The potential unknown health effects of genetically modified foods is an issue that has risen to the top of the food safety agenda. Biotechnology methods, specifically recombinant DNA techniques, are increasingly being used to create plants for food products that have enhanced resistance to pests, disease, drought, salinity, frost, and herbicides, as well as augmented nutritional value, improved processing characteristics, and better taste. Among their many benefits, biotechnological applications may allow for the reduced use of water and pesticides during cultivation of food plants (International Food Information Council, 1997). The FDA has decided that genetically altered plants should not be treated differently than other plants and, thus, the agency does not require extensive, pre-market scientific safety tests of genetically modified food products (Miller, 1999). Scientists have yet to link any specific health risks to genetically modified foods, though consumer groups sued the FDA in May 1998, claiming that the agency has failed to adequately regulate, review, and label such foods.[24]

Concerns about the unintended impacts of genetically altered plants extend beyond food safety concerns to include their unknown ecological effects. A recent study conducted by researchers at Cornell University found that larvae of monarch butterflies that had eaten milkweed leaves dusted with pollen from Bt corn, (a product sold by Monsanto, Novartis, and other companies), ate less, grew more slowly, and suffered higher mortality than larvae reared on leaves dusted with untransformed corn pollen or on leaves without pollen (Losey, et al., 1999). Bt corn is a variety of corn genetically engineered by injecting the toxin-producing genes of the soil bacterium, *Bacillus*

[24] The case, *Alliance for Bio-Integrity, et al. v. Shalala*, Docket No. 98-1300 (CKK) (D.D.C. filed May 27, 1998), is still pending.

thuringiensis. The genetically modified corn plant is capable of protecting itself from certain insect pests by producing the Bt toxin. Currently, this biopesticide is the most widely used of its type and comprises more than 50 different Bt proteins with differing toxicities for caterpillars, beetles, flies, and nematodes. In 1997, there were nearly 4 million acres of Bt corn, 2 million acres of Bt cotton, and 25,000 acres of Bt potatoes, with alfalfa, canola, soy, sorghum, and wheat containing Bt genes soon expected to reach the market (Jones, 1998). Though there remains active disagreement with respect to the implications raised in the Cornell study, as was evident at a recent symposium sponsored by the biotechnology industry (Niiler, 1999), the magnitude of use of Bt and other genetically modified seeds points to the increasing importance of this issue.

A final food safety concern that should be mentioned is with respect to the growth hormones used in animal food products. Most scientific evaluations of rBST (the genetically altered bovine growth hormone used to increase milk production) have determined that it does not pose a danger to human consumption (Aldrich and Blisard, 1998), but concerns about other similar growth hormones continue to be raised and are a source of dispute between scientists in the United States and England.[25]

Though these food safety concerns stem from the production of foods, foodservice and food retail operators are in a position to address these issues. Moreover, many consumers look to these industries to ensure a safe food supply. According to the Food Marketing Institute (1997a), 18% of supermarket shoppers assign primary responsibility to food stores to assure the safety of the food they purchase, up from less than 10% in 1996.

The simplest approach is to use or sell products that are free of these concerns (e.g., dairy products from cows not treated with growth hormones). There are numerous examples of foodservice and food retail companies taking this approach with respect to genetically modified foods, particularly in Europe. In England, most of the nation's leading restaurants have joined a campaign to call on the government to support a five-year ban on genetically modified food and crops, pending research on their impacts on

[25] The European Union (EU) has for a decade banned the importation of U.S. and Canadian beef treated with growth hormones. EU scientists have characterized commonly used growth hormones as human carcinogens. The dispute reached the level of the World Trade Organization, which has concluded that

health and the environment (*Natural Life*, 1999b). U.S.-based fast food companies operating in England, including McDonald's and Burger King, have also agreed to eliminate genetically modified foods and their ingredients from their products (Weiss, 1999b).

On the food retail side, the largest U.S. grocery chains of natural-food stores—Whole Foods Market and Wild Oats Markets—recently announced their plans to ban genetically modified ingredients from their private-label products (*Bloomberg News*, 1999). This move follows similar bans in Europe where seven major supermarkets operating in six different countries ($150 billion in collective sales) recently announced a joint initiative to source to their stores only those supplies that are free of genetic modification (*Natural Life*, 1999a). In England, moreover, many of the country's largest grocery retailers (e.g., Tesco, Sainsbury) and food processors (e.g., Unilever and Nestle) have announced the phase-out of genetically modified foods from their shelves and products (Weiss, 1999a; Environment News Service, 1999).

With the exception of the recent plans announced by Whole Foods Market and Wild Oats Markets, U.S. foodservice and food retail companies have generally not followed the lead of many of their European counterparts with respect to genetically modified foods. That said, in the food manufacturing industry, Gerber Foods and Heinz baby foods recently announced that they will not use genetically altered corn or soy ingredients (Petersen, 1999). Frito Lay, too, has announced that it will exclude genetically altered corn from some of its products (Pollack, 2000). To date, these actions have generally come in response to public perception rather than scientifically based evidence. However, if convincing evidence were to emerge linking antibiotics, genetically modified foods, and growth hormones to deleterious human health effects, these examples illustrate steps foodservice and food retail industries might take.

Other steps that could be taken to address food safety issues include working with food manufacturers to ensure that adequate protection measures are in place. HACCP systems have shown promise, and can be improved with the adoption of new technologies and expanded to include food manufacturing processes not currently

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there is no scientific evidence supporting the EU's position. See generally, *Wall Street Journal* (May 4, 1999)

required to have such systems in place (Majchrowicz, 1999; Crutchfield, 1999). Foodservice companies, for instance, can source only from food manufacturers that use HACCP protection systems. With respect to food retail operators, those that offer private label products can implement HACCP systems in their own manufacturing facilities or require that contracted manufacturers implement similar safety procedures.

Another option available to both industries is to collaborate with other food industries to clearly label products. Food safety labels are at times mandated by the FDA (e.g., unpasteurized fresh juice is required to carry a warning label indicating that the product may contain harmful bacteria), but also could be incorporated voluntarily. The next section discusses labeling and other methods of retailer information provision in greater detail.

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The objective of illustrating these different ways for foodservice operators and food retailers to affect environmental issues occurring upstream from their operations is to emphasize that these industries can leverage their position to contribute to environmental gains throughout all parts of the food marketing system. The discussion does not mean to suggest that these industries are chiefly responsible for these problems, simply that they are in a position to take action. To bolster the capacity of these industries to use this leverage, it will likely be necessary to work closely with the other industries in the food marketing system to develop some sort of "trace-back-capacity" (Welsh, 1996) or certification scheme to facilitate “green” purchasing through the supply chain. Moreover, the foodservice and food retail industries must continue to serve their consumers, which of course is a main component determining their decisions about product selection. The important linkage between these industries and consumers is explored in the next section.

5. DOWNSTREAM ENVIRONMENTAL IMPACTS

The previous section highlighted how the unique position of the foodservice and food retail industries in the food marketing system affords companies operating in these sectors opportunities to influence upstream environmental behavior. This intermediary position between those responsible for the production, manufacturing, and distribution of

food products and the consumers that purchase these food products provides similar opportunities to influence downstream environmental performance. The retailer-consumer interface is characterized by two-way communication: consumers express their preferences through their purchasing decisions and retailers provide information in various forms about the products they offer. Thus, as is the case with retail service industries in general, foodservice operators and food retailers play a key role in both satisfying and shaping consumer preferences for goods and services, including their environmental dimensions (Guile and Cohon, 1997).

This section focuses on this retailer-consumer interface. The first part of the section explores the response of the foodservice and retail food industries to changes in consumer preferences, with a focus on the demand for environmentally friendly products. The second part of the section considers opportunities for these industries to provide information to consumers about the environmental impacts of their purchasing decisions.

Responses to Changes in Consumer Preferences

The food marketing system is increasingly being designed to respond to consumer demand quickly, an important part of the ECR and EFR initiatives discussed in the previous section. Additionally, producers and processors are designing products more directly based on consumer preferences (Kinsey, et al. 1996). The impact of consumer preferences on the food products offered by foodservice and food retail operators is most evident in terms of changing consumption patterns. A detailed description of the changes in food consumption patterns is beyond the scope of this paper,[26] but a few changes stand out as particularly important.

For one, demographic changes have altered the composition of consumer society. Population growth, an aging society, increases in ethnic diversity, and shifts in household composition have led to correlated changes in the types of foods preferred by consumers. Second, changes in economics and the value of time have altered the amount of time that consumers spend on meal preparation. A shifting labor force, especially the increased percentage of women working outside of the home, and increased time spent working, have led to a rise in demand for convenience foods, take-out food, fast food, and home-

[26] For detailed analysis of the changes in food consumption patterns, see among others Putnam and Allshouse (1999), Putnam and Gerrior (1999), and Kinsey (1994).

delivered food. Third, scientific advances have led to increased knowledge about food and its relationship to health and nutrition. Enhanced knowledge provided by food labeling laws and communication about risks of certain types of foods and diets has, for instance, led to rising consumer demand for leaner meat and poultry products and fresh fruits and vegetables (Carlson, et al., 1998; Standard & Poor's, 1999; Kinsey, 1994; Manchester, 1992).

Collectively, these changes have had significant implications for food markets. In general, the increasingly discriminating consumer has forced the food industry to respond through the design of products more aligned with consumer preferences. Consequently, food industries have begun to customize products for well-defined niche markets (Barkema, 1994). Meeting the specifications of these narrower niche markets is one of the forces driving the industrialization of agriculture and a key reason why food processors are increasing their vertical coordination as a way to ensure that the inputs to their food products meet consumer preferences (Kinsey, et al., 1996; Barkema, 1994). Among the growing niche markets include products that reflect consumer demand for food that is more convenient (e.g., home-delivered food, frozen entrees, microwavable dishes), more health-oriented (e.g., health foods, natural foods, nutritionally improved foods), and produced in an environmentally responsible manner (e.g., organic foods, recycled-content packaging) (Standards & Poor's, 1999; Kinsey, 1994; Manchester, 1992), the last of which is the focus here.

Studies indicate that 6-7% of consumers consider a product's environmental impact as a primary or core factor in their buying decisions. For most consumers, though, the environmental attributes of food products constitute only one of a multitude of criteria (e.g., price, quality, brand recognition, convenience, taste, appearance, availability, cleanliness) considered in their purchasing decisions and, if considered, serve primarily as a differentiator or "tie-breaker" once consumers' basic expectations have been met (FMI, 1997c; Speer, 1997). That said, a 1997 survey conducted for the Food Marketing Institute found that 71% of respondents were either somewhat or very interested in purchasing "environmentally enhanced" products, with 37% indicating that they have made such a purchase at least once in the past month (FMI, 1997c). Other surveys have found similar results. Researchers at the Social Science Institute of the USDA Natural

Resources Conservation Service, for instance, surveyed grocery shoppers in the suburban Portland, Oregon area and found a majority (56.5%) look for products that say they are environmentally friendly (Clarke, 1999). Moreover, the Food Marketing Institute (1997d) found that, in 1997, 46% of respondents believed that it is "very important" for their primary grocery store to offer “green” or “environmentally sound” products, up from 40% in 1995.

The impact of consumer preferences for environmentally friendly food products is best evidenced by the increased popularity of the natural foods market generally, and the organic foods market, specifically. Natural foods are generally defined to include those products that are minimally processed and free of artificial ingredients, preservatives, and other non-naturally occurring chemicals (Richman, 1999; Kaufman, 1998a). Natural foods presently constitute a relatively small part of the overall retail foods market, accounting for only $5.5 billion in total retail sales in 1997. However, the natural foods retail market has had an annual growth of 25% over the past seven years, and according to some predictions, will by 2008 constitute nearly 10% ($60 billion) of the total retail foods market (Richman, 1999).

A major part of this predicted growth lies in expectations for the continued expansion of natural foods retailers, the largest of which are Whole Foods Market and Wild Oats Markets. In 1990, there were fewer than 90 natural food stores with capacities of more than 5,000 square feet. By 1997, there were more than 600 such stores, with industry experts predicting a growth to over 1,000 stores by the year 2000 (Wells, 1997). In addition to the growth in the natural foods supermarket format, conventional supermarket formats have also recognized the augmented consumer demand for natural foods products, with executives increasingly citing the value of integrating natural foods into their operations (Progressive Grocer, 1999; Richman, 1999).

An important component of the overall natural foods market, and a general proxy for consumer demand for environmentally friendly food products, are organic foods. Organic agriculture, in general, has been on the rise for most of the past decade. In 1995, the amount of certified organic cropland in the United States was 638,500 acres, up more

than 50% from 1992. The number of certified organic farms[27] also rose considerably during this period, from 2,753 to 4,856, with an estimated 6,000 additional uncertified organic farms in operation (Richman, 1999). In terms of retail sales, organic food sales equaled $4 billion in 1997, with sales predicted to be approximately $6 billion by the year 2000 (Brandt, 1998; Organic Trade Association, 2000).

An indication of the widening consumer demand for organic products is the fact that 28% of shopper's surveyed in 1997 by the Food Marketing Institute indicated that they purchased a natural or organic food item at least once a week, an increase from 24% in 1995 (FMI, 1997a). Moreover, consumer demand for organic foods is not limited to fresh produce. Empirical analysis of supermarket scanner data by Glaser and Thompson (1999) indicates that sales of organic frozen vegetables (broccoli, green beans, green peas, and sweet corn) rose an average of 58.4% per year in volume for the period September 1990 to December 1996.

A key constraint seemingly curtailing further expansion in the natural and organic foods markets is the limited price premium consumers are willing to pay for these types of food products. Though 71% of respondents to a survey conducted for the Food Marketing Institute indicated that they were somewhat or very interested in purchasing environmentally enhanced products, this percentage dropped to 46% when asked if they would be willing to make the same purchase if the product were 10% more expensive (FMI, 1997c). Furthermore, the average premium consumers are willing to pay for environmentally friendly products declined from 6.6% in 1990 to 4.5% in 1996 (Speer, 1997).

An additional constraint may relate to a general lack of consumer knowledge about the environmental impacts associated with the production and manufacturing of many food products. Retailers (both foodservice and food retail operators) are in a particularly strong position to inform consumers about the environmental impacts of the products they sell. The information provided (or not provided) by retailers, in other

[27] Several different types of entities conduct organic certification within the United States, including non-profit organizations, for-profit corporations, and state departments of agriculture. Most of these organizations and agencies provide organic certification within their own state or region, though a few provide services nationally and/or internationally. See Organic Farming Research Foundation (1999).

words, can have significant downstream environmental impacts in terms of consumer purchasing decisions, as is discussed below.

Information Provision

Through shelf and menu offerings, the foodservice and food retail industries are in large measure in control of the choices of meals and products available to consumers. As retailers, these industries are also well positioned to provide information to their consumers about the meals and products they sell. Foodservice and retail food operators can inform their customers about the environmental attributes of food products, thereby arming them with information to use, if they so choose, in their purchasing decisions. Recent survey results, moreover, indicate that consumers believe it is important to know how their food is grown (Clarke, 1999).

In general, communicating environmental information about food products can be more difficult than conveying other attributes such as price, quality, and convenience. Many environmental attributes—for instance, the relative environmental burden of a manufacturing process—are too complicated for many consumers to fully assess. Furthermore, an individual consumer's ability to translate information (e.g., data on air or water pollutants emitted during production) into the effects on their own health or public health and the environment generally is limited (EPA, 1994).

Some techniques for communicating information about food products have proven successful. Advertising and labeling, for instance, have been illustrated to be effective methods for communicating information to consumers about food-related nutritional and health issues (Mathios and Ippolito, 1998). On the food retail side, most consumers looking to buy environmentally friendly products, in fact, indicate that they use a label most often to learn about the environmental attributes of a product, more so than advertising or other sources of information (FMI, 1997c). With some exceptions (e.g., self-manufactured and store brand products in food retail), however, these types of information provision are mostly controlled by food manufacturing companies or independent organizations (e.g., third-party certification organizations, trade associations) in accordance with the standards promulgated by the FDA (or the Federal Trade Commission for nonfood products).

In addition to advertising and labeling, there are some information provision techniques that fall under the purview of foodservice and food retail operators that show promise for effectively influencing consumer purchasing decisions. With respect to foodservice operations, the primary means restaurants have to inform their customers is through the description of the meals they serve. For instance, meals prepared from organically produced food products can be labeled as such to highlight the fact that the ingredients used were not cultivated with synthetic chemicals. Using recognizable certification seals (especially if consistent with ones used in food retail operations) may be an effective technique as well. Similarly, if a restaurant decides not to serve a product for environmental reasons, this choice can be communicated to customers as a means of raising their awareness. An additional source of information provision, which may also effectively communicate the environmental implications of consumer food choices, is the strategic placement of signs and placards in restaurants (e.g., counter at a fast food outlet).

More so than foodservice operators, food retailers have the ability to influence consumer purchasing decisions through many different sources of information provision, including working with food producers, manufacturers, and trade associations to find ways to better promote and display environmentally friendly products. In addition, food retailers can independently provide information about the environmental aspects of the products they sell. Most notably, food retailers can use various types of point-of-purchase (POP) materials (e.g., signs, check-out lane displays, shelf-talker displays, video-screen displays) to inform their customers. Though most point-of-purchasing marketing is done by food manufacturers as an additional means of product promotion (Belonax, 1999), it is also a common form of information provision by food retailers. About half of consumers with a penchant for buying environmentally friendly products indicate that they use POP displays as a source of information about food items (FMI, 1997c).

A recent study illustrated the effectiveness of POP displays. Reicks, et al. (1997), in conjunction with the Midwest Organic Alliance, conducted research that evaluated the effect of POP signage on customer perceptions and purchasing behavior with respect to organic foods. The study found that when organic foods were labeled as such (the study used Earth-Friendly Organic logo channel strip labels on shelves), consumers were more

inclined to buy some of the products, than when the same organic products were not labeled. Though the results varied by product (14 different organic products were included in the study) and by store (both upscale and warehouse/discount groceries participated), the researchers concluded that POP information about organics can simplify decision-making for those aware of and interested in organic foods and can increase awareness among other segments (Reicks, et al., 1997). These preliminary results also suggest that POP information may be a useful technique for communicating other types of environmental information about the products sold in grocery stores.

Tops Markets, for example, has carried out an effective POP information initiative. This chain of stores operating in New York and Ohio has implemented a POP signage program to help customers identify organic and natural products. Green signs with the motto: "More Good Choices Naturally," have been placed throughout stores to highlight products that fit within the following three guidelines: no artificial colors, flavoring, and preservative; organic wherever possible; and environmentally friendlier (Ahold, 1998).

In addition to POP materials, the Food Marketing Institute (1997c) has identified numerous types of information grocery retailers can provide to their consumers. These include offering brochures from manufacturers, trade associations, and distributors with environmentally related product information, and combining educational information with noticeable shelf placement to help bring attention to new “green” products. Through this type of information provision, grocery retailers can have a positive downstream impact on environmental performance through education of their customers regarding the link between the products they purchase and the environment.

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In sum, the downstream environmental impacts of the foodservice and food retail industries should be understood as a set of opportunities to positively effect environmental quality. Whether by offering environmentally friendly products to consumers or providing information about the environmental implications of their purchasing decisions, operators in these industries can arm consumers with options (not requirements) to improve their environmental behavior. Of course, foodservice and food retail companies should not be expected, for instance, to offer only meals prepared with

organic ingredients or sell only items with high-recycled-content packaging. This section has illustrated, however, that companies do have opportunities to have a positive environmental impact downstream.

6. POLICY IMPLICATIONS, OPPORTUNITIES, AND CONCLUSIONS

The primary environmental impacts of the foodservice and food retail industries identified in this paper point to several policy implications. Most importantly, the direct environmental impacts of the foodservice and food retail industries are not particularly significant in terms of their magnitude (with the important exception of food safety) and, thus, do not demand new or drastically modified legal or regulatory structures. In other words, this analysis does not indicate a regulatory failure or mismanagement of environmental problems, nor lead to the conclusion that a need exists for major new government intervention, either by the EPA or another agency, to address the environmental impacts of these two industries.

Moreover, since the problems themselves are generally not unique to the foodservice and food retail industries, their management will likely best be accomplished if targeted on a cross-industry basis, with perhaps industry-specific implementation strategies designed to ensure opportunities to maximize flexibility, efficiency, and innovation. For instance, the types of solid waste generated by these industries (with the exception of food waste) are common to other service industries, especially secondary packaging waste. Efforts to address solid waste will generally be more appropriately targeted holistically, rather than as simply a problem of the foodservice and food retail sectors. Furthermore, while the upstream and downstream environmental impacts of these industries represent significant opportunities for environmental gains, they are more likely to be achieved through voluntary, incentive-based initiatives than through a regulatory regime promulgated by a government agency. Such initiatives likely have the best chance for success if designed in a collaborative fashion by the industries and government agencies.

Though a regulatory response seems inappropriate, that does not mean that improved environmental performance by the foodservice and food retail industries should not and cannot be achieved. There exists a clear set of opportunities that can be seized by

these industries to not only reduce the direct environmental impacts of their operations, but to enhance the overall environmental performance of the food marketing system. Significantly, many of the primary means for environmental advancements are directly controlled by individual foodservice and food retail companies, both in terms of mitigating restaurant or store-level impacts and through supply chain environmental management. Among the primary opportunities for foodservice and food retail industries to address their environmental impacts:

- reduce energy intensity of operations through efficiency efforts; such efforts will also lower utility expenses;
- increase recycling efforts of secondary or tertiary packaging waste; such efforts will also lower disposal expenses;
- expand ECR and EFR initiatives to include efforts to minimize environmental impacts of distribution system; greater efficiency should also result in the generation of less overall waste (e.g., food waste);
- incorporate HACCP and other food safety systems to improve handling of food;
- work with government agencies and other food marketing companies to bolster food safety systems to improve handling of food products from "farm to table;"
- encourage vertically integrated firms (mostly grocery retailers) to improve the environmental performance of their upstream, non-retailing operations (e.g., distribution, manufacturing) and the environmental characteristics of their private label products (e.g., recycled-content packaging);
- use upstream leverage over suppliers through the integration of environmental requirements or incentives in contracts and strategic alliances (e.g., include environmental criteria in ingredient and product selection);
- consider environmental attributes when purchasing from wholesalers and distributors;
- offer environmentally friendly products to help bolster their market; and
- provide information to raise consumer awareness of the environmental implications of their purchasing decisions (e.g., POP materials).

This enumeration is not meant to be exhaustive, just illustrative of the multitude of opportunities that exist to improve the environmental performance of the foodservice and food retail industries. Undoubtedly, there are also chances for individual companies to share best practices, especially with respect to addressing environmental issues such as energy and solid waste management. Intra-industry information exchange, with assistance from trade associations and other supporting industry-wide organizations, can help companies operating in these industries to identify opportunities to improve their environmental stewardship. Additionally, collaborative efforts between foodservice and food retail companies and organizations in the environmental community, such as the partnership formed in the early 1990s between McDonald's and the Environmental Defense Fund, can also facilitate a company's efforts to evaluate and address the environmental impacts of their operations.

It is important to emphasize that the policy implications and opportunities for improved environmental performance in these industries suggested above are preliminary and based on a couple of key constraints—the paucity of industry-wide data and the unknown significance of cumulative effects. With respect to lack of industry-wide data, presently there are no reporting requirements or monitoring systems in place to collect data on the environmental impacts of the foodservice and food retail industries. As a result of this dearth of industry-wide information, it is difficult to fully assess the environmental implications of these sectors. Information about the total air emissions from restaurants on a nationwide scale, for instance, does not exist, which complicates any effort to weigh the importance of the foodservice industry's emissions vis-à-vis another sector of the economy. The EPA and other government agencies should work with these industries, and other service industries in which data are similarly lacking, to develop information collection systems so that a more precise assessment of the overall environmental effects of these industries can be conducted.

A topic related to this lack of industry-wide data, and one that is relevant to most service industries, is the unknown cumulative impacts of multiple small actors. For instance, consider the case of the foodservice cooking equipment used by many fast food outlets. Considered individually, the air emissions from a single restaurant are relatively minor. However, when considered collectively, these emissions may represent a

significant source of important air pollutants. The South Coast AQMD in California concluded that the restaurants in the Los Angeles area make foodservice the fourth largest man-made source of particulate matter and VOCs in the area, and responded by promulgating regulations for chain-driven charbroilers and considering targeting other types of foodservice cooking equipment as well (South Coast AQMD, 1999; South Coast AQMD, 1997). This "multiple small actors" phenomenon may be characteristic of foodservice and food retail industries in general, which adds further impetus to the need to amass data on an industry-wide basis.

Though data limitations and uncertain cumulative impacts are constraints common to this type of industry-level research, they are particularly relevant in the study of service industries which have generally been a neglected area of analysis. Definitive conclusions regarding the adequacy of the existing environmental management system to deal with their environmental impacts should be contingent upon the collection and analysis of more complete information.

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This paper illustrates the importance of considering the environmental impacts of service sectors broadly, looking beyond the level of the service provision unit itself (e.g., retail outlet, office building) to include consideration of relationships with both suppliers and consumers. In this respect, the conceptual framework utilized in this analysis is a useful tool that can be applied to future research of service industries. While the relative importance of each of type of impact—direct, upstream, and downstream—may differ by industry, it is undoubtedly critical to evaluate each to capture the full magnitude of the environmental implications of service industries and to identify the levers for managing environmental impacts.

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