Chapter II

PRIORITIES FOR TECHNOLOGY ASSESSMENT

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Food marketing comprises the activities that take place within the food system from the farm gate to the consumer. This includes processing, wholesaling, retailing, food service, and transportation. This excludes all functions performed by producers on the farm. (See appendix A for background information on the U.S. food marketing system.)

An effective food marketing system should provide an adequate and continuous supply and variety of wholesome, nutritious foods to all consumers at reasonable prices and provide reasonable returns to producers and sellers. While simple to state, assessing performance is complex because cost efficiency is a major governing factor, and yet fulfilling other requirements may increase costs. For example, seeing that food meets safety standards may add to its cost. In the short run, a technology may increase efficiency and lower cost to the consumer, while in the longer run it could result in structural changes to the industry that could impede competition and result in less-than-reasonable prices for consumers. Any technology that would require a large outlay of capital and therefore drive out smaller firms could lessen competition and increase prices. Likewise, returns to the various segments of the system must be sufficient to attract needed capital and make changes necessary to meet performance standards.

The marketing system breaks down logically into two major segments: processing and distribution. Processing technologies are classified in this report under five headings: 1) preservation, 2) new and improved equipment and processing techniques, 3) new and modified food products, 4) new sources of food ingredients, and 5) packaging. Distribution technologies are classified under four headings: 1) wholesaling, 2) transportation, 3) retailing and food service, and 4) those technologies that cross over the above three in their application and effects.

PRIORITY SELECTION

Priorities for the processing and distribution technologies discussed in chapters IV and V are based on staff work, literature and research reviews, and contributions from public participants in the Office of Technology Assessment's (OTA) mail survey and workshops. The priorities are based primarily on probability of occurrence and expected impacts of each technology.

This section synthesizes the priorities and cuts across both processing and distribution and considers the total marketing system. It identifies the seven technologies that emerged as highest priority for future assessment (see table 1, which lists the major technologies or technological areas and the areas on which these technologies may be expected to impact). The criteria for setting priorities within this listing include how each technology affects or might affect the total marketing system, the probability of the development or adoption of that technology, and its expected impacts in relation to the food system and the social and economic climate (see chapter III).

Several technologies discussed in chapters IV and V represent technological gaps rather than developed technologies. Those technologies needing further research and development are identified at the end of this chapter.

Cross-fertilization occurs and no one impact can be singled out as the most important or far-reaching. In many cases, the adoption of Technology A will impact on Area A, while the adoption of Technology B will impact on Areas A and B and in turn affect the adoption or limit the impact of Technology A. This interrelation and interaction of technologies and impacts is, in the end, the most important consideration of a technology assessment.

Nutrition and food safety are affected by processing and packaging technologies but may also be affected by technologies in food distribution (wholesaling, retailing, transportation, food service) such as those in sanitation and loss prevention. Many of the distribution technologies are expected to affect industry structure, and in some instances this may affect how firms interact with each other, with other marketing segments, and with consumers. Capital requirements for many technologies are the prime cause for many of the structural changes that take place. Many technologies are adopted to improve productivity and substitute for labor (employment), and these generally will give rise to issues of job loss or labor relocation. The prospects for future increases in energy costs encourage development of energy-saving technologies, so that the energy-producing industries will be affected.

Many of these high-priority technologies are directly concerned with preventing losses in our food system, either through more efficient processing methods or waste reduction in the delivery system, and with producing new foods to substitute for traditional foods. This reflects the concern that between now and the year 2000 our food supply will have to be better managed and more efficiently utilized if the United States is to supply food needed in the rest of the world and keep domestic prices at reasonable levels.

What follows is a comprehensive summary of the seven highest priority technologies. They are also discussed in more detail in chapters IV and V, and the reader will be referred to the appropriate pages should more information be desired.

Table 1 .—Issue Areas of Food Marketing Technologies With High Priority for Assessment

Technologies / Impact Areas	1. Engineered foods	2. Sanitation in distribution	3. Retort pouch	4. Electronic checkout	5. Technologies to prevent food loss	6. Electronic food shopping	7. Recyclable, returnable containers
Marketing functions							
Processing	x	x	x		x		x
Packaging	x		x	x	x	x	x
Wholesaling		x	x	x	x	x	x
Retailing		x	x	x	x	x	x
Food service	x	x	x	x	x		x
Transportation	X	x	x		x		x
Nutrition	x		x		x	x	x
Food safety	x	x	x		x		x
Industry structure		x		x		x	x
Employment			x	x	x	x	x
Energy	x	x	x		x	x	x
Other resources	X		x		x		x

FABRICATED FOODS

The technologies that are used to produce fabricated, or engineered, foods are considered high-priority candidates for assessment because they are already in use, their impacts have already been felt, and it is highly probable that their development and use will continue in the years ahead. Sales of fabricated foods were more than $6 billion in 1972 and are expected to exceed $11 billion by 1980.

Fabricated foods may be divided into two types: ingredients (extenders and fillers) and analogs (substitutes).

The extender used most widely in meat products today is vegetable protein, usually from soy, in hamburger or meatloaf. Analogs are substitutes fabricated to resemble a specific traditional food, such as breakfast sausage from vegetable protein or non-dairy coffee whitener, cheese, whipped toppings, or egg substitute from vegetable oils.

Several advantages have been cited for these products: lower cost, extended food supply in times of shortages, reduction in energy use, better control of nutrient content, and more efficient utilization of resources. The issues that surface from the use of these foods, however, are already of serious concern to producers, consumers, and nutritionists, among others.

Because fabricated foods make use of a number of additives and unconventional ingredients about which official standards and regulations are frequently incomplete or in disagreement, many persons worry that those who consume these products are not being adequately protected. Others, however, believe that these regulations overly restrict the development and acceptance of what maybe a viable solution to the problem of maintaining an adequate, dependable, and nutritious food Supply.

Nutritionists and others are concerned about the effect consumption of fabricated foods may have on overall nutrient intake. While the use of vegetable protein as a meat extender or analog may be one way of pro tiding an inexpensive source of protein, the overall consequences of ingesting vegetable, rather than animal, protein (either in part or whole) have not been satisfactorily determined. On the other hand, these technologies afford the opportunity to supply specially formulated foods that will meet the dietary needs or improve the nutrient intake of selected target populations.

Two other issues that should be considered are adequate labeling and resource use. How should these foods be labeled to properly identify ingredients and yet not present barriers to consumer acceptance? If the use of these foods becomes even more widespread, how will this affect the agricultural production sector, particularly the meat, poultry, and dairy producers?

These technologies raise issues in the areas of food safety, nutrition, regulations, labeling, and resource use. (See chapter IV, p. 42.)

FOOD SANITATION IN DISTRIBUTION

Preventing the adulteration and spoilage of food is of concern throughout the food system. Since the problem of maintaining adequate sanitation is a serious one in the distribution system, particularly with the railroads, this area emerges as a high priority for assessment. Technologies and systems exist that could be used to solve this problem, although development of additional technologies is needed.

Contamination of food and food products in railcars has two major causes: cars are not cleaned adequately and may be infested with pests, chemicals, or micro-organisms; or cars used to transport food may have previously transported toxic substances, residues of which remain.

Several solutions to this problem are possible. Railroads need an efficient tracking system to monitor cars used to carry toxicants so they will not subsequently carry food or food products. Also, a method for detecting contamination in cars is needed. More thorough cleaning techniques must be developed for the rail system to have quality assurance in its freight car fleet.

Examples of possible technologies that have been suggested are:

1. Freight cars designed specifically for food products that will be more resistant to contamination and infestation.
2. Equipment and procedures for decontaminating freight cars. This would include trained inspectors operating with specific guidelines relative to food safety.
3. Freight cars specifically designed for food use and a system that will keep track of this "dedicated" fleet and schedule the cars efficiently. This must include an effective means of enforcement to maintain the integrity of the system.

A major policy issue in this area is funding the development of these technologies. At present, the railroads appear unable to secure the capital needed to initiate and maintain such a system. Serious attention should be given to the desirability of policies that would help railroads finance these needed improvements. If this system is needed and feasible, should it be encouraged through regulations, voluntary cooperation, or some type of incentive arrangement? (See chapter V, p. 54.)

RETORTABLE POUCH

The technology that produces the reportable pouch, while still being developed, has current applications; the pouch has received limited approval for use from relevant regulatory agencies (Food and Drug Administration and the U.S. Department of Agriculture). Further adoption and use of this technology can be expected to have strong impacts and far--reaching consequences throughout the marketing system, particularly in the areas of energy, food storage, transportation, and the environment. Owing to these expected impacts, reportable pouch technology ranks high on the priority list for assessment.

The pouch is a multilayer, adhesively bonded package that will withstand therm~ processing temperatures and that combines many advantages of the metal can and the plastic boil-in-the-bag. The quality of foods processed by this method is said to be superior to that of foods retorted in conventional cans, and taste tests indicate that it may approach that of frozen foods.

Energy savings are possible in processing because of shorter cooking times at lower temperatures. However, while the pouch itself would appear to offer savings in energy use, these savings can only be confirmed by a thorough analysis of different systems that are or might be used commercially.

Savings of as much as 50 percent (pouch vs. can) may be projected in the area of transportation owing to improved product-tepackage weight ratio. One question that must be answered, however, is the relative durability of the pouch for transportation purposes. Reportable pouches now in use are protected by an outer protective package, which limits the potential savings.

If this technology becomes widespread and inroads into the $17 billion frozen-food and $20 billion canned-food markets are as significant as expected, issues to be addressed include loss of revenue to producers of metal cans and industries producing raw materials, displacement and relocation of large segments of the labor force, and possibly considerable loss of jobs.

Environmental impacts of this technology may be considerable, in both a positive and a negative sense. The pouches are not recyclable, as compared to cans and most bottles, which would negate some of the initial energy and raw materials savings. However, reportable pouches can be used as fuel; therefore, even without recycling most of the energy initially expended in their manufacture could be reclaimed, while at the same time minimizing solid waste problems. It is essential that these problems be recognized, and that expected negative consequences be thoroughly assessed before industry attempts to revolutionize the food packaging industry.

ELECTRONIC CHECKOUT

Electronic checkout systems are already in use in about 300 stores, or less than 1 percent of all foodstores, in the United States as of the end of 1977, There is every indication, however, that the development and use of these technologies will continue to expand, with economic and social consequences for retailers, consumers, labor, and the telecommunications sector. Because of these impacts and the emotions they have aroused, electronic checkout technologies must be among those areas considered high priority for assessment.

At present, two electronic checkout systems have been developed. The first is an electronic cash register, which may be self-contained or tied to a central store computer. It relies on individually price-marked items and manual entry into the register. The second system, which has received the most publicity and generated the most opposition from consumers, is tied to a central computer and uses a seamer that reads the Universal Product Code (UPC) currently printed on a number of food packages. This system, like the first, has the potential to improve merchandising decisions resulting from better inventory control, improved labor scheduling, less need for storage space, more thorough analysis of sales, increased product movement, and better use of shelf space.

In addition, the UPC scanner system eliminates the need to mark prices on individual packages, since this information would be stored in the central computer and transmitted to the terminal when the UPC is read. Elimination of pricing has created most of the public opposition to this system. Bills have been introduced in more than 30 State legislatures and in the U.S. Congress to require that prices be marked on every item.

Opponents claim that lack of pricing deprives consumers of information they need to make rational purchase decisions and to assure proper charges. Proponents believe that this is outweighed by the many economic benefits that may accrue from the use of this system, stressing that this would probably result in lower food prices.

This technology will affect society in a broad sense. What particular components of the system generate savings, and how much of the savings are cash savings due to increased productivity of labor versus secondary savings from better management of inventory, pricing policies, etc. ? How much of these savings would be passed on to the consumer? How, in fact, would this technology affect consumer purchase decisions if products were not marked with individual prices? If this is indeed a problem, are there alternative solutions? How would widespread implementation of this system affect industry structure and competition, given the high initial capital required for installation (about $200,000 per store)? If individual prices were required by law, would this deter the growth of high-volume, low-price discount stores that might offer substantial savings to consumers?

The adoption of this technology would cause a reallocation of labor. How would this affect the 1.7 million foodstore employees and labor in related industries? Increased use of the electronic checkout may involve increased use of electronic funds transfer. What will be the impact on individual privacy and liability for losses and errors in the system? (See chapter V, p. 57.)

TECHNOLOGIES TO REDUCE FOOD LOSSES

Approximately one-fifth of all food produced for human consumption is lost annually in the United States. Technologies that reduce the extent of these losses can help in substantially increasing the food supply available from existing resources and will become increasingly important as worldwide pressure increases for more food. Such technologies include those that reduce waste in packaging and transportation throughout the marketing system and reduce losses that occur from pilferage and general lack of security control.

Waste resulting from mechanical harvesting might be reduced by improved harvesting technologies or by gleaning the produce left by mechanical harvesting. Waste resulting from spoilage and bruising in transportation might be reduced by using such alternatives as bulk packing at the field for shortdistance delivery to stores or by educating consumers of the benefits of damaged, but equally nutritious, produce. In addition, technologies are needed that will reduce the amount of food lost at the retail level by both pilferage and damage caused in handling.

Several questions remain unanswered, such as: What is the extent of loss in the marketing chain, when does it occur, and what technologies are available to reduce this loss? Another consideration has to do with the potential for utilizing produce that does not now meet grade standards because of size or blemishes, what consumer objections would have to be overcome to accomplish this, and would it be economically feasible? Technologies to reduce losses at retail, such as the electronic checkout for better inventory control, should be considered, as should better designed locking systems for railcars and trucks to reduce losses during transportation. (See chapter V, p. 61.)

ELECTRONIC FOOD SHOPPING

These technologies are not as likely to be widely adopted within the next 10 years as are the electronic checkout systems, but their gradual evolution would have very significant impacts on the marketing system, hence the high priority accorded them for assessment.

Three electronic food shopping systems are considered: warehouse-to-door systems, auto mated minimarkets, and mobile markets. These technologies apply primarily to large metropolitan areas and the special distribution needs of rural areas.

Possible advantages of ordering directly from warehouses and delivering directly to the consumer include savings in time to the consumer, in transportation costs, in fuel use, in convenience, and possible safety, particularly to the elderly. An assessment should analyze these technologies to determine whether they can indeed provide the same services as retail stores at less cost. Automated minimarkets, a convenience store where most items are dispensed automatically, as well as the warehouse-to-door system, are dependent to a certain extent on some type of credit, probably electronic funds transfer (EFT), which would be card-activated. Both systems are dependent, therefore, on the development and use of EFT technology.

Mobile markets would move products into certain areas on a scheduled basis. Tests indicate that this is a high-cost operation, but this cost could decrease if the operation were to become widespread.

The main advantage of all three systems is that they would make food available in imercity and rural areas, where such services may be at a minimum. The most apparent disadvantage is that with remote ordering or a smaller amount of food from which to choose, the consumer would be faced with a limited selection and in some instances would not be able to examine certain foods, particularly fresh produce, before purchase.

All of these technologies could be examined in relation to alternative systems, such as industry-cooperative programs for improving stores in the inner city, consumer cooperatives, and direct marketing by farmers in rural areas.

RETURNABLE AND RECYCLABLE CONTAINERS

Technologies for recyclable containers, returnable cans and bottles, and other refillable containers have a high probability of being an important part of our future; the impacts of adoption will be widespread. These technologies have developed because of socioeconomic pressure, and the pressure will in all events continue to build for new solutions through technology to the problems of conserving natural resources and reducing the expense of keeping our environment free of pollution from discarded containers. This is an instance of social and economic pressure creating demand that establishes the high priority given to these technologies for assessment.

Returnable and recyclable containers are being produced today, and many communities have set up collection points for cans, bottles, and other recyclable products. The public definitely seems interested in the concept of recycling, even if the specific technologies or systems to date may not have met with their approval.

These technologies fall into three categories: recyclable beverage containers, returnable and recyclable food containers, and the general concept of recycling applied to all food products. The issues, however, are generally the same for all and fall into the areas of economics and the most efficient resource utilization.

Returnables may add to the cost of distribution and handling of products (one study estimates a cost of 2 cents more per quart to deliver milk in returnable bottles), but whether this cost would be passed on to the consumer has not been determined, although it seems a reasonable assumption. Included in this issue is the high initial capital cost of converting production lines in bottling plants to handle returnables. An assessment should evaluate policies for overcoming such capital problems.

Delivery problems may also result from a widespread conversion to returnable bottles, since by law they cannot be transported in the same vehicle as new food products. This may give rise to new products that do not depend on bottles (such as powders to be mixed with water in the home).

Recovery and recycling of the materials from food containers may be one method of extending our natural resources. Various technologies for collection and processing of these materials have been initiated—for instance, large central high-technology plants for separating recyclable metal, glass, and other materials from refuse relative to separation by consumers of these materials before the refuse enters the recycling system. There may be no one system applicable for every situation, but people may have to make a choice of whether they wish to participate by paying for a centrally located or industry-based system with taxes or fees, or whether they would prefer to lower the cost by participating directly. (See chapter IV, p. 47.)

TECHNOLOGIES NEEDING MORE RESEARCH

Research is needed to further develop many technologies identified in this report that are not now in an adoptable state. The list below is not in priority order and does not include those technologies selected for high-priority assessment that would more clearly specify needs for more research.

The listing of these technologies should not imply that they are being advocated but rather that they are currently not developed to the point of adoption or that not enough research has been conducted to be able to assess their potential.

The processing and distribution technologies needing further research are:

1. More efficient utilization of water in processing (see chapter IV, p. 38),
2. Development of containers or railcars for better quality preservation (chapter V, p. 55),
3. Central cutting and packing of meat (chapter IV, p. 37),
4. Solar energy technology in processing (chapter IV, p. 40),
5. Meals-on-wheels and other delivery of complete meals to the home (chapter V, p. 60),
6. New analytical instrumentation and processes for detecting ingredients in foods (chapter IV, p. 39),
7. [ntermodal terminals constructed in main food distribution centers (chapter V, p. 56), and
8. Moisture reduction processes (chapter [V, p. 41).