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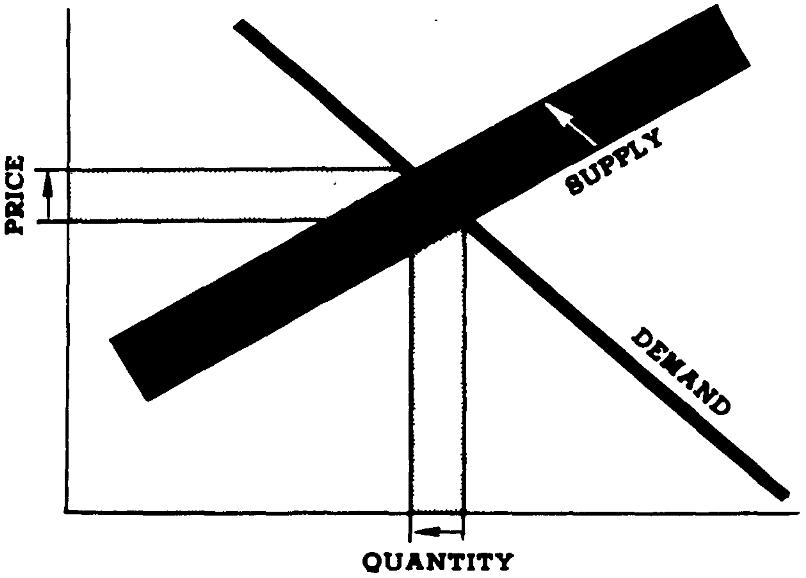
# ECONOMIC ANALYSIS
# OF
# PROPOSED EFFLUENT GUIDELINES

## Fruit & Vegetable Processing Industry



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# ECONOMIC ANALYSIS OF
# PROPOSED EFFLUENT GUIDELINES
# FRUIT AND VEGETABLE PROCESSING INDUSTRY

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To
Environmental Protection Agency

Contract No. 68-01-1533
Task Order No. 4
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# PREFACE

The attached document is a contractor's study prepared for the Office of Planning and Evaluation of the Environmental Protection Agency ("EPA"). The purpose of the study is to analyze the economic impact which could result from the application of alternative effluent limitation guidelines and standards of performance to be established under sections 304(b) and 306 of the Federal Water Pollution Control Act, as amended.

The study supplements the technical study ("EPA Development Document") supporting the issuance of proposed regulations under sections 304(b) and 306. The Development Document surveys existing and potential waste treatment control methods and technology within particular industrial source categories and supports promulgation of certain effluent limitation guidelines and standards of performance based upon an analysis of the feasibility of these guidelines and standards in accordance with the requirements of sections 304(b) and 306 of the Act. Presented in the Development Document are the investment and operating costs associated with various alternative control and treatment technologies. The attached document supplements this analysis by estimating the broader economic effects which might result from the required application of various control methods and technologies. This study investigates the effect of alternative approaches in terms of product price increases, effects upon employment and the continued viability of affected plants, effects upon foreign trade and other competitive effects.

The study has been prepared with the supervision and review of the Office of Planning and Evaluation of EPA. This report was submitted in fulfillment of Contract No. EPA-230/1-73-012, Task Order No. 4, by Development Planning and Research Associates, Inc. Work was completed as of October, 1973.

This report is being released and circulated at approximately the same time as publication in the Federal Register of a notice of proposed rule making under sections 304(b) and 306 of the Act for the subject point source category. The study has not been reviewed by EPA and is not an official EPA publication. The study will be considered along with the information contained in the Development Document and any comments received by EPA on either document before or during proposed rule making proceedings necessary to establish final regulations. Prior to final promulgation of regulations, the accompanying study shall have standing in any EPA proceeding or court proceeding only to the extent that it represents the views of the contractor who studied the subject industry. It cannot be cited, referenced, or represented in any respect in any such proceeding as a statement of EPA's views regarding the subject industry.

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# ECONOMIC ANALYSIS OF PROPOSED EFFLUENT GUIDELINES FRUIT AND VEGETABLE PROCESSING INDUSTRY

## I. INTRODUCTION

The purpose of this study is to analyze the economic impact of the cost of proposed effluent abatement requirements on selected portions of the Fruit and Vegetable Processing Industry. These requirements (effluent limitation guidelines) are being developed by EPA pursuant to the Federal Water Pollution Control Act Amendments of 1972.

### A. Scope

The industrial pollution abatement impacts that are considered in this report include those applicable to selected portions of the following Standard Industrial Classifications:

| | |
|---|---|
| SIC 2033 | Canned Fruits, Vegetables, Preserves, Jams and Jellies |
| SIC 2034 | Dried and Dehydrated Fruit and Vegetables |
| SIC 2037 | Frozen Fruits, Fruit Juices, Vegetables and Specialties |

Within these broad industry groups, emphasis is focused on the processing of five specific products: (1) citrus, (2) apples, (3) potatoes, (4) spinach, and (5) asparagus. It is understood that these products are but a limited cross-section of products in the industry. However, a principal objective of this analysis was to intensively study specific types of operations in relation to water effluent characteristics and control requirements.

The impacts considered herein are expected to apply directly to some operations, but must be considered on a "prorated" basis for others. Complications are encountered when dealing with specific products due primarily to the wide range of product combinations, product forms and varied processes which, in fact, exist in the industry. For example, processed apple products include sliced apples, apple juices, apple sauce and cider, some of which are canned, frozen or dehydrated. Apples may also be processed in conjunction with other fruits and/or vegetables.

Chapters II-IV present characteristics of the fruit and vegetable industry with a focus on the specific products indicated above. Impact analyses are presented in Chapter VII for citrus and apple products. A preliminary impact analysis of the potato processing industry is presented in Appendix A. Insufficient industry data was available for model plant analysis. Pollution control costs for spinach and asparagus were not available as expected, thus an impact analysis was not possible. Basic industry information of these segments is presented, however.

## B. Data Sources

The most commonly used and in many cases the most readily available source of industry information including employment, location, value of shipment and specific product data is the Census of Manufactures. In the case of the fruit and vegetable canning and freezing industry, an additional source is also available. This latter source is The Directory of the Canning, Freezing, Preserving Industries published by Edward E. Judge and Sons, Inc. The Directory contains data concerning plant location, volume, specific products, and type of plant and is the Directory generally recognized by industry. Both sources will be utilized throughout the report.

The problem that is encountered is that there is not perfect correspondence or relationship between these two data sources. For example, the following summary depicts the number of fruit and vegetable canning and freezing plants contained in the two references. Projections of number of plants based on the two sources is also presented in Table II-1.

Table II-1. Numbers of fruit and vegetable canning and freezing plants in the United States

| | Number of Plants | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1947 | 1954 | 1958 | 1963 | 1967 | 1970 | 1972 | 1975 | 1980 |
| From Census of Manufacturers | | | | | | | | | |
| Canners | 2,265 | 1,758 | 1,607 | 1,430 | 1,223 | 1,165 | | 1,990 | 800 |
| Freezers | 291 | 266 | 426 | 650 | 608 | 580 | | 545 | 505 |
| Total | 2,556 | 2,024 | 2,033 | 3,080 | 1,831 | 1,745 | -- | 1,445 | 1,305 |
| From Judge's Directory | | | | | | | | | |
| Canners | -- | -- | -- | -- | -- | 841 | 828 | 715 | 578 |
| Freezers | -- | -- | -- | -- | -- | 176 | 185 | 165 | 153 |
| Combination | -- | -- | -- | -- | -- | 171 | 181 | 145 | 117 |
| | | | | | | 1,188 | 1,205 | 1,025 | 848 |

As portrayed in the above summary, there is a total discrepancy of 537 plants (1,745 - 1,188) in the 1970 data. The lack of 1972 census data prevents comparing current plant numbers from the two sources.

There are several possible explanations for this data reporting discrepancy, however, it is believed that one factor can explain most of the differences. The singularily most important factor is believed to stem from the fact that census data includes all plants including the extremely small plants employing only one employee while many of these plants may have been deleted from Judge's directory. While there is no way to completely reconcile the two data sources given time and budget considerations, a few brief explorations were employed to explain the discrepancy.

A comparison of Judge's plant listings by number of plants by state with the number of plants by state with 20 employees or more as reported by census eliminates much of the data discrepancy which suggest that some of the small plants have been deleted from Judge's directory. An additional comparison between number of plants by employment size from census with number of plants by average employment according to Judge again reveals that the greatest disparity exist in the number of small processing plants as reported in the two sources. This again would seem to indicate that the difference can in large part be explained by the omission of some very small plants from Judge's directory.

In view of the fact that the Directory contains current data on number of plants, location of plants and specific products that can not be acquired from census Judge's directory must be utilized. The acquisition of other data, i.e., value of output, concentration ratios and other data, must be taken from census publications.

While the data discrepancies can not be reconciled and as such presents a few difficulties, it is largely inescapable at the present time. Number of firms and employment estimates from the two sources are presented in a later section.

The remainder of this chapter is devoted to a discussion of the industry under consideration utilizing several taxonomies or segmentations.

# II. INDUSTRY SEGMENTS

A listing of fruit and vegetable canning and freezing plants compiled from the industry directory contains a total of 1,205 commercial establishments. An additional 178 fruit and vegetable dehydrating plants are reported in the census of manufacturers which brings the total number of plants to be considered to 1,383. In view of the fact that most of these plants have diversified product lines as well as a diversity of production processes, there is a great need to segment the industry using various categories or segments. It is not sufficient, at least in the terminal steps of the report, to talk in terms of a typical apple processor or a typical freezing plant until the specific characteristics of these plants have been explored, i.e., characteristics by type of product, characteristics by type of process and characteristics by type of firm. There is a great variance in what might be called the "typical" plant.

For this reason it is desirable to devote a section of the report to a detailed industry segmentation. This is the objective of this section which presents various characteristics of the fruit and vegetable canning, freezing, and dehydrating industries. The first major section is devoted to firm and industry characteristics while later sections discuss specific plant and product characteristics.

## A. Characteristics of Fruit and Vegetable Canning, Freezing, and Dehydrating Firms

Fruit and vegetable canning, freezing, and dehydrating firms vary greatly in size, organizational structure, product mix, and degree of diversitifaction and integration. The firm and industry characteristics considered in this section include number and size of firms, degree of integration, concentration, employment and payroll.

### 1. Size and Number of Firms

#### a. Canners

A detailed analysis was made of the volume packed (in terms of cases of canned product) for 598 canners. It should be emphasized that this analysis is in terms of physical volume rather than gross sales. To avoid any possible disclosure of individual operations, only industry totals for seven volume categories were considered. Table II-1 indicates the number of firms in each volume category.

Table II-1. Size distribution, fruit and vegetable canning firms, 1970

| Size Category | Number of Firms | Percent of Total |
|---|---|---|
| (Annual volume cases canned product) | | |
| Under 100,000 | 106 | 17.6 |
| 100,000 - 250,000 | 108 | 18.1 |
| 250,000 - 500,000 | 114 | 19.1 |
| 500,000 - 1,000,000 | 99 | 16.6 |
| 1,000,000 - 2,000,000 | 66 | 11.0 |
| 2,000,000 - 5,000,000 | 44 | 7.4 |
| Over 5,000,000 | 61 | 10.2 |
| | 598 | 100.0 |

Source: The Directory of the Canning, Freezing and Preserving Industries, 1970-71.

Over a third of the firms analyzed (35.7%) would be considered small canners with an annual pack of less than 250,000 cases. At the other end of the range, 28.6 percent packed over 1,000,000 cases and would be classed as large and 10 percent of the canners packed over 5 million cases annually and would be considered in the very large group.

During the intervening time period (1970-1973) several existing industry trends have been continuing, i.e., exodus of small firms and increased dominance and number of larger, multiplant firms. It is not possible at this time to present a table comparable to Table II-1 for 1973, however, several preliminary observations are appropriate. For example, an examination of subsequent editions of Judge's Directory reveals that there has been a net decrease of 49 (134 deleted and 85 new) fruit and vegetable canning plants from the industry listing. This includes 134 plants that may have discontinued operations as a result of unfavorable profit positions or other reasons and 85 new plants that have entered the industry. It is entirely possible that some of the 134 deleted plants have not actually left the industry but have merged with other firms or changed ownership and/or mailing addresses. It is further possible that some of the plants included as "new" plants actually represent previously existing plants that have been added to the directory for the first time. Since, however, the trends are consistent with a priori industry information, there is merit in including some preliminary and qualified results or observations.

An examination and analyses of the specific characteristics of the deleted plants reveals that 80 percent of these plants were small processing plants and 6 percent were large processing plants, e.g., less than 500,000 annual cases and over 5,000,000 annual cases respectively.

On the other hand, if the emphasis is on firms as opposed to plants, the listings of new and deleted firms reveal that a disproportionally large number of the deleted plants were single firm plants. The listing of new plants reveals that most are affiliated with multi-plant firms.

These results indicate that when Table II-1 is updated to reflect the number of <u>firms</u> by annual volume, an increase in the number and importance of medium and large firms will be reflected.

b. Freezers

Volume data were available from 231 fruit and vegetable freezing firms. The distribution of sizes of these firms is shown in Table II-2.

Table II-2. Size distribution, fruit and vegetable freezing firms, 1970

| Size Category | Number of Firms | Percent of Total |
|---|---|---|
| (Annual volume million lbs.) | | |
| Under 2 | 43 | 15.8 |
| 2 - 5 | 41 | 15.1 |
| 5 - 10 | 30 | 11.1 |
| 10 - 20 | 31 | 11.4 |
| 20 - 50 | 37 | 13.7 |
| 50 - 100 | 27 | 10.0 |
| Over 100 | 62 | 22.9 |

Source: <u>The Directory of the Canning, Freezing and Preserving Industries</u>, 1970-71.

Approximately 30 percent of all firms analyzed would be classed as small freezers, with annual volume of less than 5 million pounds. However, 46.6 percent would be considered large (annual volume in excess of 20 million pounds) and 22.9 percent would be in the very large category with annual packs in excess of 100 million pounds.

Procedures similar to the above were employed to ascertain recent trends in the number of fruit and vegetable freezing firms. The results of these investigations reveal that, based solely on number of plants the freezing segment of the industry is in a better relative position in that the change in number of plants indicates an increase rather than a decrease as was the case for fruit and vegetable canners. Twenty-four freezers were deleted while thirty-six freezers were added to the directory from 1970-1973, representing a net increase of twelve freezing plants. Delineating the net addition by size produced inconclusive results with no perceptable trends in number of plants by size classification.

Segmenting the new and deleted plants by type of firm reveals that approximately 83 percent of the deleted plants are single plant firms while 50 percent of the new firms are affiliated with single plant firms. On the other hand, only 4 percent of the deleted plants were associated with firms consisting of 2 to 5 plants while 44 percent of the new plants were associated with firms consisting of 2 to 5 plants. Since the single plant firms are characteristically small producers and the multiplant firms tend to produce a larger combined total output, the results are analogous or the trends are similar to the trends previously observed in the canning segment of the industry, i.e., a shift in the number and importance of firms in the middle and upper size categories.

### c. Dehydrators

A comparable series, i.e., number of firms by annual volume pack does not exist at the present time for the dried and dehydrated fruit and vegetable processors. One alternative and perhaps the only alternative is to present the number of food dehydrators by employment class. This data is available for 1967 from the Census of Manufacturers and is summarized below in Table II-3. Census data concerning the number of canned and frozen fruit and vegetable processors by employment size is also presented in this table so as to provide insight and perspective into the relative importance of the three industry segments.

## 2. Degree of Integration

There is only a relatively small amount of vertical integration in the fruit and vegetable canning, freezing and dehydrating industries. Based on a special canner survey by the Economic Research Service, U. S. Department of Agriculture in 1964, it was estimated that only 8 percent of the fruits and vegetables canned were obtained from land owned or rented by

Table II-3. Size of fruit and vegetable processing establishments, by number of employees, census years 1954-67.

| Year | Establishments with: | | | | | Total |
|---|---|---|---|---|---|---|
| | 1-4 employees | 5-19 employees | 20-99 employees | 100-499 employees | 500 or more employees | |
| | Number | | | | | |
| Canners: | | | | | | |
| 1954 | 377 | 383 | 715 | 254 | 29 | 1,758 |
| 1958 | 285 | 409 | 627 | 266 | 20 | 1,607 |
| 1963 | 276 | 318 | 547 | 266 | 23 | 1,430 |
| 1967 | 281 | 210 | 433 | 273 | 26 | 1,223 |
| Freezers: | | | | | | |
| 1954 | 41 | 57 | 104 | 59 | 5 | 266 |
| 1958 | 51 | 112 | 138 | 111 | 14 | 426 |
| 1963 | 139 | 165 | 194 | 136 | 16 | 650 |
| 1967 | 135 | 110 | 186 | 147 | 29 | 607 |
| Dehydrators: | | | | | | |
| 1954 | 45 | 39 | 42 | 22 | 0 | 148 |
| 1958 | 49 | 45 | 41 | 26 | 0 | 161 |
| 1963 | 42 | 54 | 57 | 23 | 0 | 176 |
| 1967 | 51 | 46 | 46 | 35 | 0 | 178 |

Source: Bureau of the Census, Census of Manufactures, U.S. Department of Commerce.

canners. A comparable situation existed in the freezing industry where only 9 percent of the raw product was obtained from freezer-owned or rented land.

Over two-thirds of the supply of fruits and vegetables processed by canners and freezers is obtained through contractual arrangements with growers. Contracting with growers has provided a means whereby canners and freezers can reduce the risk of raw product supply variations from year to year without investing capital resources directly into farm production. Thus, they avoid the necessity of integrating backward into production.

Canners and freezers also have never integrated very far forward into wholesale and retail trade. Some large processors do maintain sales offices in principal wholesale markets, however, brokers handle over two-thirds of the sales of processed fruits and vegetables. A comparable situation is believed to exist for the dried and dehydrated food processing industry especially in the dehydrated potato industry which also makes extensive use of contractural grower processor arrangements.

### 3. Industry Diversification and Specialization

While most canners and freezers operate multiple-product plants and process a diversified line of fruits, vegetables and juices, these industries are nevertheless highly specialized in the processing of fruits and vegetables. A part of this specialization is location-oriented in that they are located in centers of fruit and vegetable production and another part is equipment-oriented since specialized equipment is required.

The Bureau of the Census calculates specialization ratios for different types of industries. These represent the ratio of sales value of all the primary products of the plant to its total of primary plus secondary products.

#### a. Canners

In 1967, the specialization ratio for fruit and vegetable canning plants was calculated to be 90 percent. This indicates that canned fruits, vegetables and juices represented 90 percent of the value of gross sales of these plants. Secondary products shipped by this industry consist mainly of canned food specialty products and frozen fruits and vegetables.

b. Freezers

This industry's production of frozen fruits and vegetables (primary products) in 1967 represented 92 percent (specialization ratio) of its total product shipments. Secondary products consisted mainly of canned fruits and vegetables and dehydrated food products.

c. Dehydrators

In 1967 the specialization ratio for fruit and vegetable dried and dehydrating plants was calculated to be 94 percent. The secondary products shipped consist mainly of canned and/or frozen food products.

Specialization ratios for the three industry segments are not available at this time for years later than 1967.

## 4. Concentration of Fruit and Vegetable Firms

Local area processing concentration has little meaning to the fruit and vegetable canning, freezing and dehydrating industries. Plants and firms located in any region are potential competitors to those producing the same product lines in all other regions, therefore, concentration by value of shipments is an important consideration.

a. Canners and Freezers

The canning and freezing industry is characterized by a large number of firms. Consequently the small firms share a very small segment of the total market and have very little influence on industry prices and total supply. In addition, concentration is much higher on a product than a firm basis. Table II-4 presents canning and freezing concentration ratios which show that the four largest companies account for 21 and 26 percent of the value of shipments for canners and freezers, respectively. Table II-4 also presents the concentration ratios for 1963 and 1967.

b. Dehydrators

The fruit and vegetable dehydrating industry is much smaller in size (measured by volume of annual sales) and also has a greater degree of concentration, i.e., concentration by firm domination as well as areal concentration.

Table II-4. Percent of value of shipments accounted for by largest companies in each industry segment

| | Value of Industry Shipments | | | | |
|---|---|---|---|---|---|
| | Total (Million dollars) | Percent Accounted For By | | | |
| SIC Code/year | | 4 largest companies | 8 largest companies | 20 largest companies | 50 largest companies |
| 2033 (Canning) | | | | | |
| 1970 | NA | 21 | 33 | NA | NA |
| 1967 | 930 | 22 | 34 | 52 | 70 |
| 1963 | 1, 135 | 24 | 34 | NA | 66 |
| 2034 (Dehydrated) | | | | | |
| 1970 | NA | 33 | 52 | NA | NA |
| 1967 | 134 | 32 | 50 | 75 | 96 |
| 1963 | 126 | 37 | 56 | 80 | NA |
| 2033 (Frozen) | | | | | |
| 1970 | NA | 26 | NA | NA | NA |
| 1967 | 495 | 24 | 36 | 55 | 74 |
| 1963 | 566 | 24 | 37 | 54 | 70 |

Source: Bureau of the Census, *Census of Manufacturers*, U. S. Department of Commerce.

Table II-4 presents the total value of shipments and the percent accounted for by the 4 largest, 8 largest, 20 largest and 50 largest companies for the three industry segments. As stated above, the number of firms is smaller and the concentration is greatest in the dehydrating segments of the industry. While there is considerable concentration by a few firms, the remainder of the production is contributed by numerous small firms.

Table II-4 also shows that for the years 1963 to 1970, there is some evidence of increased importance of the larger firms within the fruit and vegetable frozen food industry as the concentration ratio has increased from 24 percent in 1963 to 26 percent in 1970. The reverse is true for the canned and dehydrated segments of the industry in that the percent accounted for by the four largest firms has declined slightly.

These trends seem to be somewhat inconsistent with the increasing number of multiplant firms observed earlier. This, however, may not be the case in that the concentration ratios have been presented for the 4, 5, 20, and 50 largest firms only. This represents only a small portion of the total firms in both the canning and freezing industry. The exodus of small plants and increasing number of multiplant firms observed earlier considered all firms even the extremely small which may explain the discrepancy in the observed trends.

## 5. Total Employment in the Industry

The fruit and vegetable canning, freezing and dehydrating industries are major employers of labor in the areas in which they operate. Furter, they employ a high proportion of low-skilled seasonal workers in relation to total employment in the industry. As a result, curtailment of these processing industries would have an important impact on employment in the lower income levels in the areas concerned.

### a. Number of Employees

i. Canning Industry - The total employment in the fruit and vegetable canning plants in 1970 was 96,400 down from 100,000 in 1967 and 108,400 in 1957. A large percentage (89 percent) of all employees consisted of production workers (1967). Only sixty percent of the plants employed more than 20 people in 1967 compared with 57 percent in 1958. This segment is by far the most important of the three industry segments considered herein with 54 percent of the total employment in all three industry segments combined.

ii. Freezing Industry - In contrast to the canning industry where total employment has decreased, employment in the fruit and vegetable freezing industry increased from 39,500 in 1958 to 64,500 in 1967 and to 71,800 in 1970. This represents a gain of 63 percent from 58 to 67 and an increase of 11 percent from 1967 to 1970. Average number of employees per plant increased from 93 in 1958 to 106 in 1967, again reflecting increases in scale of operations. Production workers in 1967 represented 91 percent of total employment, up 3 percent over 1958. Sixty percent of the plants employed 20 or more people. The freezing industry employs 40 percent of the total employment of the combined three industry segments.

iii. Dehydrating Industry - The dehydrating industry (much smaller in terms of total employment) employed a total of 11,100 employees in 1967 and 10,700 in 1970. Eighty-four percent of the 1967 employees were production workers. This represents approximately 6 percent of the total employment in the combined industry segments.

b. Industry Payrolls

i. Canning Industry - In 1967, annual payroll in the canning industry totaled $473,800,000, an average of $387,000 per plant while in 1970 the total payroll was $523,800,000. Production payrolls equalled 79 percent of total payroll in 1967. The average annual earnings per employee was $4,732 in 1967.

ii. Freezing Industry - Total annual payroll in the fruit and vegetable industry in 1967 was $295,200,000 and $389,900,000 in 1970. Production payrolls equalled 78 percent of total payroll in 1967. Average annual earnings per employee were $4,576 in 1967.

iii. Dehydrating Industry - Total payroll for the dehydrating industry was $58,000,000 in 1967 and $68,700,000 in 1970. Production workers claimed 75 percent of the 1967 payroll.

## B. Number of Plants and Employees in Each Segment

One aspect of the discussion that is of obvious importance is the number of plants and employees in each industry segment. This information is summarized below. The detail of these estimates are presented in greater detail in subsequent sections. For this reason the summary is presented below in tabular form without further supporting explanations.

Table II-4a. Number of plants and employees by industry segment

| | Number of Plants | Estimated Number of Employees |
|---|---|---|
| SIC [1] | | |
| 2033 (Canning) | 1,223 | 100,100 |
| 2034 (Dried & Dehydrated) | 178 | 11,100 |
| 2037 (Freezing) | 607 | 64,300 |
| Specific Products [2] | | |
| Apples | 144 | 14,655 |
| Citrus | 105 | 10,602 |
| Asparagus | 60 | 7,305 |
| Spinach | 52 | 7,165 |
| Potatoes | 103 | 13,250 |

[1] Number of plants and employees by SIC from 1967 Census of Manufactures

[2] Number of plants from The Directory of the Canning, Freezing and Preserving Industries, 1972-73.

Employment estimates are based on average employment of 55, 90, 190 for small, medium and large plants respectively. These employment estimates have been suggested by personnel closely associated with the canning and freezing industries. It is believed, however, that these average employment estimates are somewhat low for citrus and potato plants.

## C. Characteristics of Fruit and Vegetable Canning, Freezing and Dehydrating Plants

A more convenient, readily available, and in some cases a more meaningful summary is derived by segmenting the industry by plant characteristics rather than by firm characteristics. This summary may be preferred in that operating decisions are perhaps based on individual plant data as opposed to firm data. Operating or closure decisions will probably proceed on a plant by plant basis within the multiplant firms in that some plants may share a disproportionately large share of the total burden of mandatory pollution abatement standards and subsequently discontinue operations while perhaps newer, more effluent and profitable plants will be virtually unaffected.

A variety of plant characteristics including but not limited to size, location, number, utilization and efficiency are presented in the ensuring discussion.

### 1. Number and Location of Plants

A summary of the recently published industry directory indicates that there are 1205 fruit and vegetable canning and freezing plants in the U.S. this includes 828 fruit and vegetable canners, 196 fruit and vegetable freezers and 181 plants that can and freeze fruit and/or vegetables. Table II-5 presents the total number of fruit and vegetable canners, freezers and combination plants in the U.S. by economic region.

Table II-5 shows that all thirteen economic regions within the contiguous 48 states contain fruit and vegetable canning plants with 473 or 57 percent located in four economic regions -- Atlantic, Upper Great Lakes, North Central and the Pacific Southwest region. All regions with the exception of the South Center and Southwest Plains Region also contain fruit and vegetable freezing plants. One hundred thirty-four or 68 percent of all fruit and vegetable freezing plants are located in the Pacific Northwest, Pacific Southwest, Atlantic and Gulf Coast and Eastern Great Lakes Regions. There are combination plants, i.e., canners and freezers in all regions with the exception of region six -- Central Plains Region. Four regions, i.e., Eastern Great Lakes, Lower Great Lakes, Atlantic and Gulf Coast and the Pacific Northwest Regions, contain 61 percent of all combination plants.

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Table II-5. Number of canning, freezing and combination plants by economic region (1972) [1]

| Type of Plant | Economic Region [2] | | | | | | | | | | | | | | Percent of all plants |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Total | |
| Canner | 132 | 69 | 56 | 101 | 107 | 14 | 47 | 38 | 52 | 16 | 24 | 39 | 133 | 828 | 69 |
| Freezer | 15 | 23 | 17 | 2 | 5 | 1 | 9 | 5 | 22 | 0 | 8 | 55 | 34 | 196 | 16 |
| Both | 20 | 21 | 33 | 9 | 4 | -- | 5 | 3 | 21 | 3 | 8 | 35 | 19 | 181 | 15 |
| Total | 167 | 113 | 106 | 112 | 116 | 15 | 61 | 46 | 95 | 19 | 40 | 129 | 186 | 1,205 | 100 |
| Percent of total | 14 | 9 | 9 | 9 | 10 | 1 | 5 | 4 | 8 | 2 | 3 | 11 | 15 | | 100 |

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[1] Source: The Directoryof the Canning, Freezing and Preserving Industries, 1972-73, Edward E. Judge & Sons, Winchester, Maryland

[2] Economic Regions of the U.S.:

1. Atlantic Region
2. Eastern Great Lakes Region
3. Lower Great Lakes Region
4. Upper Great Lakes Region
5. North Center Region
6. Central Plains Region
7. Central and Eastern Upland Region
8. Southeast Coastal Plains Region
9. Atlantic and Gulf Coast Region
10. South Center and Southwest Plains Region
11. Rocky Mountain Region
12. Pacific Northwest Region
13. Pacific Southwest Region

The number of fruit and vegetable dehydrating plants by census region is presented in Table II-6 which shows that fruit and vegetable dehydrating plants are concentrated primarily in the western producing regions -- 76 percent of all dehydrating plants are localed in the West Census Region. This is explained by the importance of potatoes, raisins and prunes as major dehydrated commodities.

Table II-6. Number of fruit and vegetable dehydrating plants by Census region (1967)

| Census Region | Number of Plants | Percent of Total |
|---|---|---|
| Northeast Region | 20 | 11 |
| North Central Region | 15 | 8 |
| South Region | 7 | 4 |
| West Region | 136 | 76 |
| Total U.S. | 178 | 100 |

Source: Bureau of Census, Census of Manufactures, U.S. Dept. of Commerce

## 2. Size of Plant

Segmenting the fruit and vegetable canning and freezing plants by volume of annual pack illustrates the dominance of small plants in these segments of the industry. A similar segmentation for combination plants shows that approximately 79 or 44 percent of all combination plants are classified as medium sized plants.

Table II-7 shows the number and percent of fruit and vegetable canning and freezing plants by volume of annual pack.

A listing of fruit and vegetable dehydrating plants by size classification can not be expanded beyond that presented in Table II-3.

Table II-7. Number and percent of canning and freezing plants by volume of annual pack

| Type of Plant | Size Classification | Number of Plants | Percent of total |
|---|---|---|---|
| Canners | Small (up to 500,000 annual cases) | 390 | 47 |
| | Medium (500,000 to 5 million annual cases) | 203 | 25 |
| | Large (Over 5 million annual cases) | 235 | 28 |
| Total | | 828 | 100 |
| Freezers | Small (up to 10 million pounds) | 82 | 42 |
| | Medium (10 to 100 million pounds) | 73 | 37 |
| | Large (over 100 million pounds) | 41 | 21 |
| Total | | 196 | 100 |
| Combination Plants (Canners and Freezers) | Small | 58 | 32 |
| | Medium | 79 | 44 |
| | Large | 44 | 24 |
| Total | | 181 | 100 |

Source: The Directory of the Canning, Freezing and Preserving Industries, 1972-1973.

## 3. Single Plants vs Multiplants

All of the 1,205 canning, freezing and combination plants were classified according to whether they belonged to single plant or multiplant firms which produced the distributions presented in Table II-8.

The dominance of plants affiliated with single plant firms is again obvious in that more than 50 percent of all plants -- canners, freezers or combination plants -- are single plant firms.

The absence of a comprehensive listing of all fruit and vegetable dehydrating plants necessitates confining the above discussion to fruit and vegetable canners and freezers only.

## 4. Number of Plants by Type of Product

An additional segmentation, i.e., type of plant by type of product reveals that approximately 55 percent of all canners process vegetables only while the remainder process only fruit (21 percent) or <u>both</u> fruit and vegetables (24 percent). The distribution of the number and percent of freezer and combination plants by type of product is presented in Table II- 9. A relatively large percentage of freezers process fruit only while the percentage of plants processing <u>both</u> fruits and vegetables is relatively constant by type of plant.

Table II-8. Number of plants per firm

| | Total Number and Percent of Plants Belonging to: | | | | | | |
|---|---|---|---|---|---|---|---|
| | Single Plant Firms | | Few Plants per Firm | | Many Plants per Firm | | |
| Type of Plant | No. | Percent | No. | Percent | No. | Percent | Total |
| | | | (2-5) | | (6 and over) | | |
| Canner | 457 | 55 | 189 | 23 | 182 | 22 | 828 |
| Freezer | 109 | 56 | 66 | 34 | 27 | 14 | 196 |
| Combination | 96 | 53 | 63 | 35 | 22 | 12 | 181 |
| Total | | | | | | | 1,205 |

Source: The Directory of the Canning, Freezing and Preserving Industries, 1972-1973.

Table II- 9. Type of plant by type of product

| | Total Number of Plants and Percent by Type of Product | | | | | |
|---|---|---|---|---|---|---|
| Type of Plant | Number Vegetable Only | Percent by Type | Number Fruit Only | Percent by Type | Number Both Fruit & Vegetable | Percent by Type |
| Canner | 451 | 54 | 176 | 21 | 201 | 24 |
| Freezer | 77 | 39 | 80 | 41 | 39 | 20 |
| Both | 53 | 29 | 85 | 47 | 43 | 24 |

Source: The Directory of the Canning, Freezing and Preserving Industries, 1972-1973.

### 5. Number of Products by Type of Plant

Most canning, freezing and combination plants are multiproduct plants with approximately 70 percent of all plants engaging in the processing of two or more products. The distribution of type of plant by number of products packed is presented in Table II-10. This table is again concerned with only canning, freezing or combination plants in that comparable data has not as of this point been located for fruit and vegetable dehydrating plants.

The advantages to be gained by processing several products include increasing the length of the processing season due to different harvest dates by type of crop, avoiding crop failures and adverse price and demand fluctuations associated with a single product and greater utilization of plant capacity.

### 6. Age of Plants and Level of Technology

Level of technology is difficult to assess in the fruit and vegetable industry. Many of the plants are relatively old, but throughout their useful life new equipment has been added or used to replace that which is old or technologically obsolete. As a result, most plants in the industry are a combination of old and new equipment. Generally, the newer equipment installed represents a higher level of technology than the old.

In a recent survey by the National Canners Association the age of plants was investigated. 1/ Approximately 200 plants were surveyed and the approximate years at the site is given in Table II-11 along with the years since the last expansion (Table II-12 also contains Seafood and Specialty plants). Only 13 percent of the plants were less than 10 years of age and 8 percent from 10-19 years. Seventy-nine percent of the plants were located at the same sight for more than 20 years. Sixty-two percent of the plants have undergone a major expansion program in the last five years, however, and another 19 percent had undergone expansion moves since 1960. Nineteen percent had not expanded since 1959 or earlier.

A large majority of the plants surveyed in the New England, North Central and Mountain Regions were over 40 years old. By commodity the oldest plants spread throughout the three classifications of fruit, tomato and vegetable canning plants. By comparison the Seafood and Specialty plants were relatively newer.

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1/ National Canners Association.

Table II- 10. Number of products by type of plant

| | Number and Percent of Plants by Type and Number of Products | | | | | | |
|---|---|---|---|---|---|---|---|
| Type of Plant | Number of Single Product Plant | Percent by Type | Number of Few Product Plants (2-5) | Percent by Type | Number of Many Product Plants (6 and over) | Percent by Type | Total |
| Canners | 289 | 35 | 483 | 58 | 56 | 7 | 828 |
| Freezers | 67 | 35 | 112 | 57 | 17 | 9 | 196 |
| Combination | 60 | 33 | 116 | 31 | 5 | 3 | 181 |
| Total | 416 | | 711 | | 78 | | 1,205 |

## Table II- 11. Percent of Canning Plants in Various Age Groupings by Location and Commodity and Years Since Last Major Expansion

| | Location | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Years at site | New England | Middle Atlantic | South Atlantic | North Central | South Central | Mountain | North-west | Alaska | South-west | Total |
| 0 - 9 | 8 | 9 | 9 | 9 | 16 | 0 | 17 | 30 | 14 | 13 |
| 10 - 19 | 8 | 9 | 12 | 5 | 5 | 0 | 11 | 10 | 9 | 8 |
| 20 - 39 | 8 | 34 | 49 | 16 | 53 | 27 | 49 | 25 | 34 | 33 |
| 40 - 59 | 53 | 34 | 21 | 50 | 21 | 46 | 18 | 10 | 37 | 33 |
| 60+ | 23 | 14 | 9 | 20 | 5 | 27 | 5 | 25 | 6 | 13 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Years since last expansion | | | | | | | | | | |
| 65 - 69 | 46 | 55 | 64 | 62 | 68 | 50 | 63 | 85 | 60 | 62 |
| 60 - 64 | 8 | 25 | 12 | 22 | 5 | 20 | 21 | 5 | 20 | 19 |
| 50 - 59 | 8 | 8 | 18 | 11 | 16 | 10 | 9 | 10 | 12 | 11 |
| Before '50 | 38 | 12 | 6 | 5 | 11 | 20 | 7 | 0 | 8 | 8 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

| | Type | | | | |
|---|---|---|---|---|---|
| Years at site | Fruit | Tomato | Vegetable | Seafood | Specialty |
| 0 - 9 | 9 | 9 | 10 | 17 | 14 |
| 10 - 19 | 8 | 0 | 7 | 15 | 13 |
| 20 - 39 | 40 | 30 | 32 | 26 | 30 |
| 40 - 59 | 34 | 45 | 40 | 23 | 30 |
| 60+ | 9 | 16 | 11 | 19 | 13 |
| Total | 100 | 100 | 100 | 100 | 100 |
| Year since last expansion | | | | | |
| 65 - 69 | 53 | 61 | 64 | 63 | 67 |
| 60 - 64 | 23 | 17 | 22 | 7 | 16 |
| 59 - 59 | 14 | 15 | 7 | 15 | 10 |
| 50- | 10 | 7 | 7 | 15 | 7 |
| Total | 100 | 100 | 100 | 100 | 100 |

Source: National Canners Association

To arrive at some level of efficiency for plants in various age categories, (assumed to reflect the level of technology) the Department of Interior report The Cost of Clean Water, Volume II, No. 6, [1] was used. The capital costs and annual operating and maintenance costs were estimated for old (1950), prevalent (1963) and new (1967) plants. These estimates were converted to an index of investment and operating costs for selected plants (Table II-12).

The above procedure can be utilized for fruit and vegetable canning and freezing plants. Comparable procedures will have to be developed if dehydrating plants are included.

## 7. Plant Efficiency

Plant efficiency is even a broader concept which includes factors such as age, level of technology, utilization, capacity and many other factors. It is obviously not possible to discuss or even ascertain many of these factors on a firm or plant by plant basis. For this reason only a few passing comments and a general summary are extended at this time.

Capacity is defined as the output which a canning or freezing plant is capable of producing during a given time under specified conditions. Normal capacity is the output per unit of time which can be realized under usual operating conditions. Maximum capacity is the greatest output obtainable, per unit of time, with existing plants and equipment. Excess capacity equals capacity minus volume processed through a plant during a given time period.

Utilization of capacity is the degree to which normal capacity is attained in the output of a plant during a given period.

Utilization of capacity is an important factor in the financial success of a given plant and utilization is affected by a number of supply, operating and sales factors. These factors are summarized in Table II-13.

Little information is available concerning capacity and utilization of capacity in canning and freezing plants. The only authoritative study in this area was done in the Southern Region. [2] Pearson found that canning plants in the South utilized only 57 percent of their vegetable processing capacity against 74 percent for freezers. As a general rule, the plants largest in size utilized a greater portion of their capacity.

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[1] The Cost of Clean Water, Vol. III, Industrial Waste Profile No. 6, Canned and Frozen Fruits and Vegetables, FWPCA, U.S. Dept. of Interior, 1967.

[2] Pearson, James L., "Utilization of the South's Vegetable Processing Capacity, Department of Agr. Econ., Fla. Agr. Exp. Sta. and Econ. Res. Sv., USDA, Ag Econ. Res. Rpt. EC68-5, January 1968.

Table II- 12. Index of Investment and Operating Costs for Old, Prevalent, and New Technology by Size of Plant

| | Small Plant | | Medium Plant | | Large Plant | |
|---|---|---|---|---|---|---|
| | 2,000 cases/day | | 10,000 cases/day | | 30,000 cases/day | |
| | Capital Cost | Annual O&M | Capital Cost | Annual O&M | Capital Cost | Annual O&M |
| Old Technology (1950) | 62 | 107 | 62 | 115 | 58 | 114 |
| Prevalent Technology (1963) | 80 | 100 | 85 | 107 | 83 | 108 |
| New Technology (1967) | 100 | 100 | 100 | 100 | 100 | 100 |

Source: Adapted from The Cost of Clean Water, Vol. III, Industrial Waste Profile No. 6, Canned and Frozen Fruits and Vegetables, FWPCA. U. S. Dept. of Interior, 1967.

Table II-13. Summary of factors affecting utilization of capacity within fruit and vegetable processing plants

| | Factor | Comments |
|---|---|---|
| 1. | Length of Harvest Season by Product | Year to year variation exists |
| 2. | Distribution of Raw Product Supplies Within Harvest Season | Varies from year to year, but generally peaks within season. Delays occur from lack of availability |
| 3. | Sales demand | Year to year variation affects planned pack |
| 4. | Raw Product Quality/Recovery Percentage | Percent of raw product recovered varies product quality |
| 5. | Level of Maturity of Raw Product | Can vary within a season and affects quality |
| 6. | Degree of Additives to the Raw Product | May alter normal utilization in terms of raw product processed. |
| 7. | Productivity of Labor/Job Performance | Varies somewhat and effects utilization of plant capacity |
| 8. | Number of Products & Schedule | Multiproduct plants may have overlapping and competing seasons. Capacity is affected by definition. |
| 9. | Variations in container Sizes | Affects raw product volume capacity |
| 10. | Warehouse and Inventory Conditions | Plant schedules may vary with associated warehouse space and/or inventory conditions |

Due to the fact that there is substantial year-to-year variation in the production of fruits and vegetables, 10-20 percent excess capacity, above normal, is desirable to enable the industry to process the production of larger-than-normal years.

By increasing processing line rates per hour and by extending hours worked or by adding shifts, it was estimated that canning plants could increase their capacity above "normal" levels by 25 percent or more.

In summary, it is apparent that appreciable excess capacity exists in both the canning and freezing industries. In general, utilization of capacity is higher in larger plants and in intensive, commerical production areas. It is also recognized that there are other factors that must be considered. These, however, will be deferred to a later time and section. It is worthwhile to mention that most of these relevant factors will have to be explored at the industry level in that time and effort constraints and more importantly data availability prevents discussing these factors on a plant level.

## D. Characteristics of Specific Product Segments of the Industry

As previously mentioned, the emphasis of this report is to focus on five specific products or product types within the fruit and vegetable canning, freezing and dehydrating industry. These include the processing of apples, asparagus, spinach, potatoes and citrus. As was adequately demonstrated above, a delineation by specific products encounters several difficulties, i.e., most fruit processors deal with a variety of products including many other fruits and other vegetables. Vegetable processors seldom produce a single vegetable product and when they do it is likely to be a major vegetable such as the processing of numerous variety and types of peas, beans or corn.

There is therefore the obvious need to further segment the industry to ascertain the specific characteristics of plants processing the above mentioned specific products.

### 1. Citrus

The characteristics of the citrus processing industry are developed below so as to provide insight into the salient characteristic of the segment of the industry. The discussion includes products packed by volume and location, size of citrus plants, employment and other specific plant characteristics.

### a. Citrus Products and Pack Volumes

Citrus products include the following specific products:

Citrus Sections
1. Grapefruit sections
2. Orange sections
3. Citrus salad

Citrus Drinks
1. Lemonade concentrate
2. Orange
3. Pineapple-grapefruit
4. Pineapple-orange

Citrus Juices
1. Single strength grapefruit
2. Grapefruit concentrate
3. Grapefruit-orange
4. Lemon
5. Lime
6. Single strength orange
7. Orange concentrate
8. Tangerine

The volume packed by production area for selected citrus products is shown in Table II-14 through Table II-18.

### b. Citrus Processing Plant Characteristics

A detailed analysis of the 1972-73 industry directory indicates that there are 105 plants that process citrus products and 103 citrus processing firms. A further breakdown of plants by specific product shows that only 41 of the 105 plants process only citrus products. The remainder (64) process other fruits or vegetables in addition to citrus products. The typical citrus plant is therefore a multiproduct plant, multiproduct across other product lines.

Even within the group of citrus plants that deal exclusively with citrus products, there is a variety of specific citrus product mixes or combinations. The following distribution (Table II-19) of exclusively citrus producing plants by specific citrus product shows that the largest number is engaged in the processing of citrus juices.

Table II-14. U.S. pack of canned grapefruit segments by state
(Thousands of actual cases -- pack beginning year shown)

| State | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970* |
| Florida | 4,610 | 2,985 | 3,394 | 4,077 | 4,413 | 5,239 | 3,772 | 3,800 | 3,726 | 3,629 |
| Texas | 11 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| U.S. Total | 4,621 | 2,985 | 3,394 | 4,077 | 4,413 | 5,239 | 3,772 | 3,800 | 3,726 | 3,629 |

*1971-72 pack to 4/29/72 Florida only, basis 24/2's - 2,562,792 cases as reported by Florida

Source: Division of Statistics, National Canners Association

Table II-15. U.S. packs of canned orange juice by states
(Thousands of actual cases -- pack beginning year shown)

| State | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970* |
| Florida | 15,423 | 12,772 | 10,157 | 13,027 | 13,466 | 15,803 | 11,895 | 13,702 | 14,266 | 13,368 |
| Texas | 723 | -- | -- | -- | NA | 519 | 305 | 878 | (a) | 1,776 |
| California & Arizona | NA | 595 | 482 | 469 | 679 | 1,308 | 352 | 1,111 | 2,816 | 1,822 |
| U.S. Total | 16,146 | 13,367 | 10,639 | 13,496 | 14,145 | 17,629 | 12,551 | 15,691 | 17,082 | 16,966 |

*1971-72 pack to 4/29/73 Florida only basis 24/2's - 9,660,217. Cases as reported by the Florida Canners Association
(a) Included in California and Arizona
Source: Division of Statistics, National Canners Association

Table II-16. U.S. packs of canned grapefruit juice
(Thousands of actual cases -- pack beginning year shown)

| State | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970* |
| Florida | 8,907 | 7,829 | 4,665 | 8,721 | 10,671 | 15,565 | 11,756 | 12,586 | 14,711 | 17,393 |
| Texas | 355 | -- | -- | -- | 658 | 1,579 | 684 | 2,681 | (a) | 4,174 |
| California & Arizona | 549 | 551 | 997 | 1,020 | 886 | 1,233 | 1,622 | 1,940 | 5,369 | 2,287 |
| U.S. Total | 9,811 | 8,380 | 5,662 | 9,741 | 12,215 | 18,377 | 14,063 | 17,207 | 20,080 | 23,854 |

*1971-72 pack to 4/29/72 Florida only, basis 24/2's 19,224,837 cases as reported by the Florida Canners Association
(a) Includes California and Arizona
Source: Division of Statistics, National Canners Association

Table II-17. U.S. packs of canned blended grapefruit and orange juice by state
(Thousands of actual cases -- pack beginning year shown)

| | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| State | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 |
| Florida | 3,248 | 2,622 | 2,006 | 2,019 | 2,203 | 2,705 | 1,689 | 1,908 | 1,799 | 1,791 |
| Texas | 39 | -- | -- | NA | NA | 44 | 28 | 56 | (a) | 93 |
| California & Arizona | NA | 13 | 128 | 65 | 180 | 303 | 92 | 176 | 186 | 161 |
| U.S. Total | 3,288 | 2,635 | 2,135 | 2,084 | 2,384 | 3,053 | 1,809 | 2,141 | 1,984 | 2,046 |

*1971-72 Pack to 4/29/72 Florida only, basis 24/2's - 1,655,588 cases as reported by Florida Canners Association

(a) Included in California and Arizona

Source: Division of Statistics, National Canners Association

Table II-18. U. S. packs of frozen citrus juices
(thousands of gallons)

| | Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 |
| Concentrated Citrus Juices | | | | | | | | |
| Orange | 53,674 | 88,869 | 70,831 | 127,611 | 83,697 | 108,043 | 126,402 | 125,187 |
| Grapefruit | 2,573 | 4,000 | 3,971 | 5,485 | 1,814 | 5,920 | 4,294 | 6,870 |
| Grapefruit-Orange | 130 | 70 | 50 | 29 | 10 | 36 | 16 | 18 |
| Lemon | NA | NA | NA | NA | NA | NA | NA | NA |
| Lemonade | NA | NA | NA | NA | NA | NA | NA | NA |
| Limeade | 1,196 | 862 | 795 | 503 | 541 | 852 | 1,345 | 1,648 |
| Tangerine | 1,146 | 1,154 | 715 | 1,120 | 582 | 1,051 | 785 | 1,090 |
| Citrus Juices, Single Strgth & Purees | 1,576 | 1,188 | 1,470 | NA | NA | NA | NA | NA |

Source: THE ALMANAC of the Canning, Freezing, Preserving Industries, for 1972.

Table II-19. Breakdown of 41 exclusively citrus producing plants by type of product produced

| Citrus Product | Number of Plants |
|---|---|
| Sections only | 1 |
| Drinks only | 3 |
| Juices only | 18 |
| Sections and juices | 7 |
| Drinks and juices | 8 |
| Sections, drinks, and juices | 4 |

Source: The Directory of the Canning, Freezing and Preserving Industries, 1972-73.

Table II-20 provides a breakdown of the specific plant characteristics for all 105 citrus producing plants. Factors considered include number of plants by type of product, type of plant, size of plant and number of products.

Table II-20. Number of plants by specific characteristics

| | | |
|---|---|---|
| | Type of Product | |
| Citrus Only | Fruit Only | Fruits and Vegetables |
| 41 | 70 | 35 |
| | Type of Plant | |
| Canners Only | Freezer Only | Both |
| 68 | 17 | 20 |
| | Size of Plant | |
| Small | Medium | Large |
| 36 | 43 | 26 |
| (Under 500 thousand canned cases; under 10 million frozen pounds) | (500 thousand to 5 million cases; 10 million to 100 million frozen pounds) | (Over 5 million cases for canners; over 100 million pounds for freezers) |
| | Number of Products | |
| Single | Few | Many |
| (Citrus only) | (2 to 5 products--citrus and other than citrus) | (6 and over, products--citrus and other than citrus) |
| 41 | 39 | 25 |

Source: The Directory of the Canning, Freezing and Preserving Industries, 1972-73.

Table II-20 reveals that only 39 percent of all citrus producing plants process only citrus products, 67 percent process only fruit (citrus and other fruit products) while 33 percent of the plants process fruits and vegetables. Sixty-five percent are canners, 16 percent are freezers, and 19 percent are combination freezer-canner plants. Approximately one-third are classified as small, 40 percent are medium and 25 percent are large plants on the basis of annual pack volumes. Approximately 60 percent of the plants are multiproduct plants. On the basis of the above percentages only, it appears that the typical citrus plant is a small to medium sized canner that processes many citrus and other fruit products.

Employment statistics by plant by specific product cannot be obtained from government sources at the present time. An alternative is to estimate employment based on average employees by size of plant (volume pack). The following data were derived from a report by the National Canners' Association, [1] for the entire industry. This provides a general basis for developing employment estimates for the industry segments in this study:

| Item | "Small" | "Medium" | "Large" | "Extra-Large" |
|---|---|---|---|---|
| Plant Size (1,000 Tons Raw Product) | .5-5 | 10-20 | 50-100 | 200-500 |
| Number of Plants | 1,450 | 500 | 170 | 30 |
| Employees | | | | |
| Peak Period | | | | |
| . Estimate [2] | 105 | 380 | 1,035 | 2,600 |
| . Range | 42-170 | 300-500 | 850-1300 | 1900-4000 |
| Average per Month | | | | |
| . Estimate [2] | 55 | 145 | 400 | 870 |
| . Range | 20-85 | 120-180 | 330-500 | 750-1100 |

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[1] "Liquid Wastes and The Economic Impacts of Pollution Control; Fruit and Vegetable Processing Industry," Progress Report, National Canners Association, July 1973.

[2] Weighted average of employees by size category. Weighted by number of plants in NCA report.

As indicated, a wide range of plant sizes and associated employment levels exist in the fruit and vegetable processing industry as a whole. Ideally, account should be taken of the specific products involved and the labor requirements on a product by product basis. However, in lieu of more precise information, the procedure for indicating general employment levels of plants in this study is to multiply numbers of plants by "size" times the average monthly employment estimates above, i.e.,

| | | |
|---|---|---|
| Small plants | - | 55 employees |
| Medium plants | - | 145 employees |
| Large plants | - | 400 employees |

The estimates for "Extra-Large" plants are not used since less than 2 percent of all plants are believed to fall into this category. Also, it is noted that peak period employment is from about 2 to 2.5 times as large as the average monthly employment. Characteristically, fruit and vegetable processors employ many additional part-time employees during peak periods of the packing season.

The procedure stated produces the following average monthly employment estimates for the citrus processors:

Total Estimated Employment - Citrus

| Small Plants | Medium Plants | Large Plants | Total U.S. |
|---|---|---|---|
| 1,980 | 6,235 | 10,400 | 18,615 |

## 2. Apples

### a. Apple Products and Pack Volumes

The apple products listed in the industry directory include the following specific products.

1. Baked apples
2. Apple rings
3. Sliced apples
4. Applesauce
5. Crabapples
6. Apple cider
7. Apple drinks
8. Apple juice

Many of these products are of only minor importance and need not be considered further. Pack statistics for the major products of interest are presented in Table II-21 to II-24 by national total and major producing state. These statistics show that apple sauce is clearly the most important specific product of those included, i.e., apple sauce, apple juice and packs of whole and sliced apples .

### b. Apple Processing Plant Characteristics

The industry directory indicates that there are 144 plants engaged in the production of canned and frozen apple products. This included 128 separate firms. A further analysis of the industry listing shows that there are only 29 plants that devote their total production capacity to various apple products. The distribution of these 29 plants by specific product is presented in Table II-25.

A further breakdown of the 144 plants by specific plant characteristic is presented in Table II-26.

Table II-21. U.S. pack of canned apple sauce by state
(Thousands of actual cases -- pack beginning year shown)

| | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| State | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970* |
| New York | 6,265 | 6,508 | 5,474 | 5,782 | 6,512 | 6,068 | 6,543 | 5,793 | 6,289 | 6,518 |
| Maryland, Pennsylvania, and Virginia | 7,679 | 8,669 | 8,475 | 10,069 | 11,300 | 5,987 | 9,800 | 9,863 | 11,111 | 8,577 |
| Michigan | 2,082 | 1,378 | 2,050 | 2,674 | 3,377 | 2,659 | 2,989 | 3,170 | 3,850 | 3,833 |
| Washington, Oregon, Idaho | 272 | 425 | 903 | 515 | 612 | 893 | 835 | 321 | 1,457 | 783 |
| California | 2,640 | 2,777 | 2,791 | 3,941 | 1,730 | 3,103 | 1,934 | 3,501 | 3,129 | 2,342 |
| Other States | 725 | 642 | 1,141 | 1,445 | 1,538 | 850 | 1,385 | 1,423 | 1,698 | 1,594 |
| U.S. Total | 19,663 | 20,399 | 20,834 | 24,426 | 25,070 | 19,561 | 23,487 | 24,073 | 27,533 | 23,647 |

*1971-72 pack to April 1 - 24,498,925 actual cases compared with 23,053,689 in same period 1970-71.

Source: Division of Statistics, National Canners Association

Table II-22. U.S. pack of canned apple juice by state
(Thousands of actual cases -- pack beginning year shown)

| | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| State | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 |
| Pennsylvania & Virginia | 1,660 | 2,196 | 2,341 | 2,576 | 2,512 | 2,034 | (a) | (a) | (a) | (a) |
| East | NA | NA | NA | NA | NA | NA | 5,088 | 5,214 | 6,881 | 7,946 |
| Michigan | 1,255 | 785 | 1,145 | 1,113 | 1,700 | 940 | (a) | (a) | (a) | (a) |
| Michigan & Other MW | NA | NA | NA | NA | NA | NA | 1,632 | 1,791 | 2,100 | 2,692 |
| California | 1,283 | 1,344 | 1,151 | 1,933 | 934 | 1,379 | 982 | 1,629 | 1,792 | (a) |
| Other West | NA | NA | NA | NA | NA | NA | 1,327 | 1,006 | 2,730 | 3,834 |
| Other States | 2,776 | 3,158 | 3,921 | 4,162 | 4,524 | 4,600 | (a) | (a) | (a) | (a) |
| U.S. Total | 6,974 | 7,483 | 8,558 | 9,784 | 9,670 | 8,953 | 9,029 | 9,641 | 13,503 | 14,472 |

Source: Division of Statistics, National Canners Association

Table II-23. U. S. pack of canned apples by state
(Thousands of actual cases -- pack beginning year shown)

| State | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970* |
| New York | 1,002 | 928 | 974 | 1,055 | 1,005 | 1,033 | 1,001 | 927 | 809 | 626 |
| Maryland, Pennsylvania, & Virginia** | 2,360 | 2,414 | 2,300 | 2,266 | 2,737 | 1,567 | 2,047 | 2,007 | 1,682 | 1,007 |
| Washington, Oregon, & Idaho | 233 | 424 | 485 | 317 | 345 | 515 | 385 | 314 | 328 | 301 |
| Other States | 392 | 270 | 302 | 290 | 322 | 368 | 243 | 356 | 308 | 388 |
| U.S. Total | 3,986 | 4,036 | 4,062 | 3,928 | 4,409 | 3,483 | 3,676 | 3,604 | 3,128 | 2,271 |

*1971-72 pack to April 1st - 2,535,062 basis 6/10's compared with 2,183,369 in same period 1970-71

**Beginning 1970 does not include Maryland

Source: Division of Statistics, National Canners Association

Table II-24. Total U.S. frozen pack of apples and applesauce
(Thousands of pounds)

| | Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 |
| Apples and Applesauce | 86,843 | 93,392 | 94,352 | 97,634 | 117,218 | 122,293 | 100,370 | 96,999 |

Source: THE ALMANAC of the Canning, Freezing, Preserving Industries, for 1972.

Table II-25. Distributuion of 29 apple(only) plants by specific product

| Product | Number of Plants |
|---|---|
| Sliced only | 4 |
| Juice only | 1 |
| Cider only | 4 |
| Sauce only | 2 |
| Cider and juice | 8 |
| Sauce and juice | 2 |
| Sliced, sauced, cider and juice | 1 |
| Sauce, cider, and juice | 4 |
| Sliced, sauce, and juice | 2 |
| Baked, rings, sliced, sauce, cider, and juice | 1 |
| Total | 29 |

Table II-26. Characteristics of apple processing plants

| Number of Plants by Specific Characteristic | | |
|---|---|---|
| | Type of Product | |
| Apples Only | Fruit Only | Fruits and Vegetables |
| 29 | 58 | 57 |
| | Type of Plant | |
| Canner | Freezer | Both |
| 97 | 28 | 19 |
| | Size of Plant | |
| Small | Medium | Large* |
| 63 | 42 | 39 |
| | Number of Products | |
| Apples Only | Few<br>(2 to 5 products--other than apples) | Many<br>(6 or more products other than apples) |
| 29 | 51 | 63 |

* Size categories correspond to those used in Table II-20.

Source: The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73.

The above tabulations indicate that 80 percent of the apple processing plants also process other fruits and vegetables. Most (67 percent) are canners, 19 percent are freezers while the residual can and freeze apple products. Forty-four (44) percent are small sized plants and 42 percent process many products, i.e., six or more products other than apples. The typical apple processing plant is therefore (based on the above percentages) a small canner that processes a diversity of products.

Employment in the above specific product sector of the industry can be estimated in a manner analogous to that used to derive estimated employment in citrus plants. The same average employment figures were utilized and the results are as follows:

Total Estimated Employment - Apples

| Small Plants | Medium-sized Plants | Large Plants | Total U.S. |
|---|---|---|---|
| 3,465 | 6,090 | 10,400 | 25,155 |

## 3. Spinach

### a. Number of Plants and Volume of Pack

The industry directory indicates that 52 plants from 42 firms engage in canning and/or freezing spinach. There are, however, no plants that devote their total production to spinach. Table II-27 presents the canned spinach pack by production area and total frozen spinach packs.

### b. Spinach Plant Characteristics

The specific plant characteristics or patterns established in the above discussion are equally appropriate for spinach processors. In fact, there are no processors that devote their entire production line to the processing of spinach. As Table II-28 indicates , the 52 plants that process spinach are not specialized by product or type of plant.

Table II-27. Canned and frozen spinach packs by state
(Thousand of cases, basis 24 No. 303 cans
for canned, thousand pounds for frozen)

| | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| State | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 |
| Canned | | | | | | | | | | |
| Arkansas, Oklahoma & Tennessee | 2,591 | 2,688 | 2,268 | 2,485 | 2,914 | 2,380 | 3,564 | 2,975 | 2,197 | 332 |
| California | 3,801 | 3,296 | 3,815 | 2,670 | 2,809 | 4,064 | 3,320 | 2,928 | 3,129 | 4,181 |
| Other states | 874 | 2,047 | 1,558 | 1,240 | 1,231 | 965 | 1,116 | 678 | 1,944 | 3,162 |
| Total | 7,266 | 8,031 | 7,641 | 6,395 | 6,854 | 7,409 | 7,990 | 6,577 | 7,270 | 7,675 |
| Total U.S. Frozen | NA | NA | 126,957 | 122,264 | 142,931 | 153,228 | 153,960 | 107,182 | 145,694 | 156,991 |

Source: Division of Statistics, National Canners Association

Table II-28. Number of spinach plants by specific characteristics

| Number of Plants by Specific Characteristic | | |
|---|---|---|
| | Type of plant | |
| Canner | Freezer | Both |
| 27 | 23 | 2 |
| | Type of Product | |
| Vegetable | | Fruit and Vegetable |
| 30 | | 22 |
| | Size of Plant* | |
| Small | Medium | Large |
| 9 | 15 | 28 |
| | Number of Products | |
| Single | Few | Many |
| (Spinach only) | (2-5) | (6 and over) |
| 0 | 15 | 37 |

* Size categories correspond to those used Table II-20.

Source: *The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73.*

Approximately half of all spinach plants are canning plants. The plant listings also indicate that 58 percent of the spinach processing plants process other vegetables while 42 percent process fruit products in addition to vegetables. Only 17 percnnt of all spinach processors are classified as small while 54 percent are large processing plants. As indicated earlier, there are no processors that process only spinach. Approximately 70 percent of those plants that process spinach process at least 6 other fruit or vegetable products.

Employment estimates are again derived by estimating plant employment by plant size classification. The distribution is as follows: [1]

Total Estimated Employment - Spinach

| Small Plants | Medium Plants | Large Plants | Total |
|---|---|---|---|
| 495 | 2,175 | 11,200 | 13,870 |

## 4. Asparagus

### a. Asparagus Plants and Pack Volumes

The situation for asparagus is very comparable to that of spinach. There are 60 plants consisting of 58 firms that process asparagus. Again, all of these plants pack other fruits or vegetables and none are devoted exclusively to asparagus processing.

### b. Asparagus Processing Plant Characteristics

The characteristics of the 60 plants that process asparagus must again be viewed as characteristics associated with fruit and vegetable canning and freezing plants in general. Table II-29 presents the general characteristics of the 60 plants that process asparagus.

---

[1] Estimates reflect plant employment and not product line (spinach) employment per se.

Table II-29. Specific plant characteristics of 60 plants that process asparagus.

| Number of Plants by Specific Characteristics | | |
|---|---|---|
| | Type of Plant | |
| Canner | Freezer | Both |
| 40 | 18 | 2 |
| | Type of Product | |
| Vegetable | | Fruit and Vegetable |
| 26 | | 34 |
| | Size of Plant | |
| Small | Medium | Large |
| 17 | 18 | 25 |
| | Number of Products | |
| Single | Few | Many |
| 0 | 40 | 20 |

Source: *The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73.*

The above table indicates that asparagus processors consist mostly of canners that process a variety of other fruit and vegetable products. The size distribution on the basis of annual pack indicates that approximately 60 percent are small and medium sized plants while 40 percent are large plants.

## 5. Potatoes

### a. Potato Products and Pack Volumes

The industry directory includes the following potato products·

1. Whole or sliced
2. French fried
3. Hash browns
4. Flakes
5. Sticks
6. Salad

A summary of the industry directory indicates that 103 plants and 89 firms process potato products. This includes 29 plants that process potatoes and only potatoes. A breakdown of other plant characteristics is presented in Table II-30.

Applying average employment figures by size of plant produces the following employment distribution:

Estimated Total Employment - Potatoes
(Potato Canning and Freezing Only)

| Small | Medium | Large | Total |
|---|---|---|---|
| 1,265 | 4,495 | 19,600 | 25,360 |

The data for the potato segment reflects only canning and freezing operations listed in the Directory which excludes many major potato dehydrators.

## 6. Dehydrating Plants

The above discussion has summarized many salient characteristics of plants producing citrus, apples, spinach, asparagus and potatoes. For the most part, dehydrating plants have been deleted from the discussion with the summary information presented for canning and freezing plants only. With the exception of apples and potatoes, the above products are not dehydrated in significant quantities. For example, the 1967 Census of Manufactures indicates the following dehydrated products and processing volumes.

Table II-29. Specific plant characteristics of 60 plants that process asparagus.

| Number of Plants by Specific Characteristics | | |
|---|---|---|
| | Type of Plant | |
| Canner | Freezer | Both |
| 40 | 18 | 2 |
| | Type of Product | |
| Vegetable | | Fruit and Vegetable |
| 26 | | 34 |
| | Size of Plant | |
| Small | Medium | Large |
| 17 | 18 | 25 |
| | Number of Products | |
| Single | Few | Many |
| 0 | 40 | 20 |

Source: The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73.

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Table II-30. Plant characteristics of 103 potato processing plants.

Number of Plants by Specific Characteristic

Type of Product

| Vegetable Only | Fruit and Vegetable |
|---|---|
| 75 | [illegible] |

Size of Plant

| Small | Medium | Large |
|---|---|---|
| 23 | 31 | 49 |

Number of Plants

| Single Plant Firms | Few Plants (2-5) | Many Plants (6 and over) |
|---|---|---|
| 29 | 22 | 52 |

Type of Plant

| Canner | Freezer | Dehydrator | Canner & Freezer | Canner & Dehydrator | Freezer & Dehydrator |
|---|---|---|---|---|---|
| 49 | 32 | 6 | 6 | 2 | 8 |

Source: The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73.

| Product | Volume<br>(million pounds) | Percent of total pack |
|---|---|---|
| Raisins | 402.2 | 28 |
| Prunes | 288.3 | 20 |
| Figs | 21.4 | 1 |
| Dates | N.A. | N.A. |
| Apples | 31.1 | 2 |
| Other fruit | 50.8 | 4 |
| Potatoes | 322.4 | 22 |
| Other Vegetables | 136.0 | 9 |
| Other fruits and vegetables (not elsewhere classified) | 14.6 | 1 |
| Soup mixes and other products | 173.4 | 12 |
| Total Pack | 1,442.2 | 100% |

Since the dehydrating segment of the industry is relatively small when compared with the canning and freezing segments, and the specific products to be emphasized herein are not important dehydrated commodities, it is suggested that this report should concentrate on only the two major segments of the industry.

Further work should be done in reference to the potato dehydrating industry. It is recognized that the specific plant data contained in The Directory is not adequate for potato dehydrating. The directory cannot be used to acquire potato dehydrating data. Other sources have been explored but as of this time specific plant data for potato processors is not available.

## 7. Model Plants

As may be expected from the results of the above summary of specific plant characteristics by specific product; some difficulty has been encountered in constructing model plants that adequately typify the production.

Model plants have been constructed for apples, citrus and spinach products. This includes both canned and frozen products. A more detailed discussion of model plants for these commodities as well as a discussion of data problems encountered in constructing model potato plants is presented in Chapter III.

## E. Specific Products Relative to the Industry

The preceding section has discussed the plant characteristics of the five specific products that are to be considered in this report. The importance of these products relative to the total fruit and vegetable canning, freezing and dehydrating industries has not been explored.

The objective of this section is to place the problem in perspective by exploring the importance of these products relative to the fruit and vegetable canning, freezing and dehydrating industries.

### 1. Specific Vegetable Products Relative to the Canned Vegetable Industry

The relative importance of any specific product can best be portrayed simply by presenting the volume of annual pack by specific product relative to the appropriate industry totals. This information is presented below for canned asparagus, potatoes and spinach.

| Product | Volume Pack (thousands of cases --24 No. 303) | Percent of total canned vegetable pack (1970 by product to 1970 total vegetable pack) |
|---|---|---|
| Asparagus | 5,972 | 2.1 |
| Potatoes, white | 6,602 | 2.3 |
| Spinach | 7,270 | 2.6 |
| Total | 19,844 | 7.0 |

Annual volume pack for the three products totaled only 19,844 thousand cases on a 24 count 303 basis. This amounted to 7 percent of the total canned vegetable pack. On a product by product basis the summary shows that all of the specific products accounted for approximately 2 percent of the total canned vegetable pack. On the other hand green beans, sweet corn and canned tomatoes contributed 45 percent of the total canned vegetable pack. The specific vegetable products considered herein must therefore be viewed as relatively minor components of the vegetable canning industry.

## 2. Specific Vegetable Products Relative to the Vegetable Freezing Industry

The situation is quite different for the specific products relative to the frozen vegetable segment of the industry. The following summary shows that potatoes account for over 50 percent of the frozen vegetables pack while asparagus comprises .6 percent and spinach 3 percent.

| Product | Volume Pack */ | Percent of total frozen vegetable pack |
|---|---|---|
| Asparagus | 29,959 | 0.6 |
| Potatoes, white | 2,565,118 | 56.0 |
| Spinach | 156,991 | 3.0 |

*/ Thousands of pounds

## 3. Specific Fruit Products Relative to Total Packs of Canned Fruit and Fruit Juices

Table II-31 shows that canned apples comprise only one percent of the total canned fruit and fruit juice packs while apple juice contributes 7 percent to the total canned fruit and fruit juice packs. Apple sauce, however, constitutes 12 percent of the total canned fruit and fruit juice pack. Together apples, applesauce and apple juice constitute 20 percent of the total canned fruit and fruit juice pack.

Citrus is also a major commodity in the canned fruit and fruit juice segment of the industry. Twenty-three percent of the total pack consist of citrus fruit and citrus juice packs.

## 4. Specific Fruit Products Relative to Frozen Fruit Industry

A similar review of U.S. pack statistics reveals that frozen apples and apple sauce comprise 15 percent of the total frozen fruit industry pack. Frozen citrus packs also contribute a substantial portion and must be considered to be a major commodity in the total frozen fruit pack.

Table II-31. Summary of canned fruit and fruit juice packs

| | 1970<br>(thousands of actual cases) | Percent 1970 to total fruit and juice, 1970 |
|---|---|---|
| **Fruits** | | |
| Apples | 2,271 | 1 |
| Applesauce | 23,647 | 12 |
| Grapefruit sections | 3,629 | 2 |
| Total all fruits | 135,405 | 66 |
| **Fruit Juices** | | |
| Apple juice | 14,472 | 7 |
| Grapefruit juice | 23,854 | 12 |
| Orange juice | 16,966 | 8 |
| Bl citrus juice | 2,046 | 1 |
| Total fruit juice | 69,725 | 34 |
| Total all fruits and fruit juices | 205,130 | 100 |

Source: The Almanac of the Canning, Freezing, Preserving Industries, 1972. Edward E. Judge & Sons. Westminster, Md., 1972.

### 5. Specific Products Relative to the Dehydrating Industry

A review of 1967 census data reveals that the dehydrated food industry shipped a total of 1,442 million pounds of fruit, vegetables and dehydrated soup mixes. A breakdown of the specific dehydrated products was presented earlier.

## F. Significant Impacts in the Industry

Because of the unique structure and competitiveness of the fruit and vegetable processing industry, pollution abatement standards when imposed on the industry will have serious consequences on the industry itself. The magnitude of this impact will, of course, depend on the level of investment required to meet the specific standards. The smaller third--and to some extent the middle third of the plants are expected to be seriously impacted. They may not be able to recover the cost of installing and operating the abatement facilities unless they have access to low cost facilities or municipal treatment. The specific plant impacts will, of course, depend on many factors such as size of plant, profitability of the plant, location and availability of low cost treatment strategies, and prevailing waste water treatment facilities. Some of these factors are discussed below.

### 1. Capacity of Low Cost Producers Relative to High Cost Producers

The capacity of low cost producers relative to high cost producers is the single-most important factor in considering the impact of pollution abatement costs imposed upon the industry. The industry is currently operating at about 75 percent of capacity. In the canning industry the largest third of the plants pack approximately 80 percent of the total volume. The middle-third of the plants pack about 15 percent, and the smallest-third can only 5 percent of the total pack. Due to economies of scale, the larger plants already have a definite cost advantage. The imposition of high pollution abatement costs on the smallest-third of the plants, and to a large extent the middle-third, will result in further dis-economies to the low volume plants. If the small plants are forced to shut down (unless of course low cost abatement procedures can be utilized, such as municipal sewage plants) the low cost-high volume plants in the industry could easily offset possible losses in capacity among the high cost producers.

Location of plants with excess capacity is another aspect which must be considered; and this factor will require further analysis .
For many products, regional distributions of alternative-sized plants are not uniform. Hence, significant regional dislocations in processing (and at the grower level) could be expected in that there are counties throughout the U.S. that have a significant percentage of their labor force employed in small processing p'ants--which are expected to be severely impacted.

## 2. Factor Dislocations Within the Industry

Differential impacts from pollution abatement controls are expected within the fruit and vegetable processing industry, both in terms of type of firm and in regional location of affected plants. The impacts expected and reasons for associated dislocations are as follows.

### a. Types of Firms and Their Location

As explained earlier, the fruit and vegetable processing industry is comprised of many firms differing in process (canning, freezing) products processed (multi/single), size (rate per hour), length of season (long/short), capacity and utilization of capacity, level of technology (new/old) and other factors. Many of these factors were considered in above preliminary analyses and the most critical measure in terms of assessing a firm's ability to withstand the impact of internalized pollution abatement costs is its overall through-put size.

In order to represent types of firms in the industry, a series of plants were defined and referred to as being either small, medium or large. In all cases, these plants were reflective of through-put size or total volume packed.

i. Marginal Firms - Within the fruit and vegetable industry, marginal firms are typically the "small" and single plant firms. This is particularly true in terms of a small firm's ability to financially withstand the projected high capital investment requirements of internalized pollution abatement measures. Such plants simply lack capacity to pay-out such investments (at the levels given). Many single plant firms also lack the capital acquiring ability of larger multiplant firms.

Within this framework, marginal firms faced with the decision to either curtail employment or shutdown would most likely shut down. Pollution abatement investment costs would be an incentive to expand production, not lower it, in order to cover additional costs.

Because of rather widespread underutilization of total capacity in the industry, it is not expected generally that marginal firms will attempt to expand their existing facilities to achieve desired economies of scale; the competitive structure of the industry will influence outward migration of firms. As previously mentioned, downward trends in the number of both canning and freezing plants is occurring. Pollution abatement controls are expected to hasten this downward trend of total firms in the industry.

ii. Locational Impacts - Only general patterns of location of plants by size category have been assessed in this Phase of the study, but from this alone it is believed that regional differences in impact will occur following standard adoption of pollution abatement controls.

Another study recently completed has shown that on the basis of average employment estimates and probable closures the county unemployment generated could be as great as 4 percent of total county employment in selected counties.

### 3. Reasons for Dislocations

Reasons for the above type of firm and location-dependent expected dislocations within the industry have been described generally already. A summary in terms of profitability and capital availability is appropriate, however.

i. Profitability - Profitability of firms, but particularly the smaller inefficient and under capitablized firms, will be affected by pollution abatement measures. While average incremental costs for pollution abatement are expected to be passed through to consumers, the smaller firms are expected to have much higher than average per unit costs of abatement.

Economies of scale in pollution control are apparent, and this is naturally to the relative disadvantage of smaller firms. As previously suggested, many of the smaller firms might be forced out of the industry. This would have a limited desirable impact on the remaining firms in that pollution control costs could be spread over a larger volume. Thus, the level of profitability of the surviving plants might be affected less on average.

ii. Capital Availability - Capital within the fruit and vegetable industry is obtained primarily from commercial sources outside the industry and from the investment of profits. Additional capital requirements for financing pollution abatement measures will also principally be sought from such sources.

In this case, availability of additional capital is expected to be determined by an individual firm's ability to project adequate net returns following an expanded investment program. Consequently, capital availability is expected to be directly related to profitability--and the smaller, inefficient firms will have difficulty raising the needed capital to stay in business. In this sense lack of capital availability will contribute to the shutting-down of marginal processing firms. In this regard single plant firms are also in an unfavorable position relative to multiplant firms.

## 4. Narrowing the Study Scope

It is difficult to narrow the scope of the study at this time. When viewing only the industry structure efforts could be concentrated on the smaller individual firms that may be severely impacted to the point of shutdown. However, to fully understand the ultimate severity of financial impact both large and small firms must be analyzed.

Continued effort on spinach and asparagus will yield little results that can be generalized for the entire industry. This is primarily because both are minor products and processed in conjunction with many different products which cut across most of the major vegetables and some fruits. If the Guidelines developed and related costs for achieving those Guidelines cannot be generalized for other major products processed in conjunction with spinach and asparagus, little can be derived in terms of total impact on the industry.

# III. FINANCIAL PROFILE

To ascertain the economic impact of pollution abatement costs on alternative product segments of the fruit and vegetable processing industries, it is critical to assess probable differential impacts among representative plants within the industry. All firms are not expected to be affected equally in terms of per unit cost of abatement. Economies of scale will exist in controlling pollutants associated with processing.

A microeconomic evaluation of plants within the fruit and vegetable processing industry for the product segments as outlined in the RFP is needed to assess probable impacts within the industry. From this base of information, overall impacts on the industry can be meaningfully projected.

The model plant data are then compared with certain financial data on the canning and freezing industries obtained from IRS financial ratios and other industry sources. These data, however, are based on broad industry averages and do not permit examination of individual product or plant situations. In the absence of specific plant or product data, the industry averages do provide some broad benchmarks for evaluation purposes.

## A. Model Plants by Segment

The basic methodological approach used in this analysis involves economic engineering--synthesis of cost and return data for individual representative processing plants within the given product categories. A broad range of "representative plant operations" has been developed in order to generalize the individual plant impacts. A key variable or factor in this regard is size of operation, e.g., small, medium and large, for various fruit and vegetable processing plants. Patterns of impact among different size categories across different products are important in terms of generalizing from individual plant data.

Economic performance of these representative plants are presented herein on an annual basis. When costs of pollution abatement are obtained from EPA for the final analysis, the performance of these representative plants will be evaluated over a period of 20 years of simulated operation. Two situations of primary concern are: (1) simulation of plant operation without internalized pollution abatement controls, and (2) simulation of operations with such controls.

Representative plants for which economic cash flows were developed are shown in Table II-1. Because of the wide variety of products produced in each segment, the analysis has been confined to major product lines recognizing that minor product lines are not included. Representative plants were selected on the basis of major products packed and availability of detailed plant data.

Small, medium, and large plants were analyzed for the high volume lines of citrus, apple and spinach. Based on average industry production, a small plant was developed with a throughput approximately equal to the average throughput of the smallest 33 percent of the firms in the industry. Normally, this amounts to 100 to 200 cases per hour. Likewise, for the middle third, a representative plant was developed for each major product. Throughputs ranged from 200 to 500 cases per hour for the middle sized plants. Average size for large firms in each product line ranged from 600 to 1,500 cases. Freezing plants were based on a similar scale based on pounds of finished product rather than cases.

It should be noted that approximately two-thirds of the plants (both canning and freezing) are multiproduct firms. However, this analysis was limited to specific products so the multiplant concept was excluded. Multiproduct plants normally process any variety of products depending on the local supply availability. Two exceptions to this generalization are the potato industry and citrus industry where a plant may process various types of potato and citrus products, but generally have not integrated across product lines to the same extent.

## Potatoes

After a search of the USDA, Universities, and trade organizations, no information regarding individual plant volume, cost of processing or investment was obtained for the potato industry. (Limited information was obtained regarding total pack by types, plant numbers, and total volume trends as contained in Chapter II. Also, see Appendix A.)

## Citrus

Model plants were developed for two major citrus products, frozen concentrated orange juice and single strength canned orange juice. Three plants, small, medium, and large were conducted for each product (see Table III-1). Length of season was set at 2,880 hours which represents a 6 month processing season from early January through June. Plants operate 7 days a week and frequently 24 hours a day during the heavy season. Sixteen hours per day was used as an average.

Table III-1. Capacities, length of operating season and annual pack for representative canning and freezing plant.

| Product | Unit | Size | Operating Capacity Per Hour | Length of Season | Annual Pack |
|---|---|---|---|---|---|
| | (cases or lbs. | | | (hours) | (90% util.) |
| Orange juice, frozen conc. | 48/6 oz. | S | 140 | 2,880 | 360,000 |
| " | | M | 490 | 2,880 | 1,260,000 |
| " | | L | 1,000 | 2,880 | 2,700,000 |
| Orange juice, ss canned | 12/46 oz. | S | 100 | 2,880 | 259,200 |
| " | | M | 200 | 2,880 | 518,400 |
| " | | L | 500 | 2,880 | 1,296,000 |
| Apple slices, canned | 6/10 | S | 200 | 900 | 162,000 |
| " | | M | 400 | 900 | 324,000 |
| | | L | 600 | 900 | 495,000 |
| Apple juice, canned | 12/3 | S | 218 | 900 | 176,400 |
| " | | M | 435 | 900 | 352,800 |
| " | | L | 653 | 900 | 529,200 |
| Apple slices, frozen | lbs. | S | 9,600 | 900 | 7,776,000 |
| " | | M | 19,200 | 900 | 15,552,000 |
| " | | L | 28,800 | 900 | 23,328,000 |
| Spinach, canned | 303 eq | S | 100 | 500 | 45,000 |
| " | | M | 400 | 500 | 180,000 |
| " | | L | 1,200 | 500 | 540,000 |
| Spinach, frozen | lbs. | S | 1,500 | 500 | 675,000 |
| " | | M | 6,000 | 500 | 2,700,000 |
| " | | L | 22,500 | 500 | 10,125,000 |

Basic plant data was obtained from an annual series of publications by A. H. Spurlock entitled "Cost of Processing, Warehousing and Selling Florida Citrus Products", Food and Resource Economic Department, University of Florida. Data used was for the 1971-72 season.

Processing costs (no capital investment costs included) were analyzed for other canned juices including grapefruit, tangerine, and blended. Cost of processing varied only by one cent per case with the exception of tangerine which averaged about 5 cents per case difference. It was determined that orange juice would represent adequately the other juices.

Frozen orange concentrate represents 93 percent of the total frozen citrus concentrate pack and was used in this analysis.

## Apples

Four major types of apple processing plants were developed: canned slices, canned sauce, canned juice and frozen slices. Dried and dehydrated apples were omitted as they represented only 6 percent of the total amount processed. Length of season for the various size plants was set at 900 processing hours.

Basic plant data on processing and investment costs was obtained from Jorge Gutierrey Villarreal, "Investment Alternatives in the Processing of North Carolina Apples," Department of Economics, North Carolina University, 1972. These costs were updated to the 1971-72 pack year and discussed with industry specialists.

## Spinach

Model plants for both canning and freezing of spinach were developed. It should be noted at this point that no record of a single line spinach processing plant could be found. All plants that process spinach also process other fruits and vegetables. Three sizes of plants for both freezing and canning of spinach with a length of season determined to be 500 hours were developed from published sources. In each case, data were constructed from simulated plant operations versus actual industry costs as used in the citrus plants. The basic data sources are Mathia,Pearson and Ela, "An Economic Analysis of Canning Leafy Greens, Lima Beans and Southern Peas," Economics Information Report No. 18, Department of Economics, North Carolina State University at Raleigh, 1970, and Brocher and Pearson, "Commercial Freezing of Six Vegetable Crops in the South," MRS Report No. 926, Economic Research Service, USDA, 1971.

### Asparagus

No detailed information regarding cost of processing asparagus could be obtained from published sources. After discussion with various industry specialists, it was determined that work on this industry has not been completed. As with spinach, no plants could be identified that process only asparagus.

## B. Model Plant Configuration

The detailed specification for each model plant configuration are presented in Tables III-2 to 8. Revelant portions are then summarized in Tables III-9 to 11.

### 1. Utilization

It is generally recognized that fruit and vegetable plants are currently operating at a level of less than capacity. For the purposes of this report plants costed out at 100 and 90 percent of operating capacity during the operating season.

### 2. Description of Cost and Revenue Components

Revenues - are based on the average f. o. b. plant prices for the canning year. These prices were obtained from various recognized published sources including: Canning Trade, Quick Frozen Foods, and others.

Raw product costs - were developed on the basis of the tonnage of raw product required to yield a given number of cases or product of processed product. Average f. o. b. plant prices were used for the 1971-72 processing season.

The following physical relationships were used:

Frozen orange juice concentrate - 135 lbs. oranges per case, 48/6 oz.
Canned single strength orange juice - 68 lbs. oranges per case, 12/46
Canned apple slices - 67 lbs. apples per case, 6/10
Canned apple sauce - 31 lbs. apples per case, 24/303
Canned apple juice - 100 lbs. apples per 9 gals. juice
Frozen apples - 100 lbs. apples per 72 lbs. frozen
Spinach, canned - 18. 18 lbs. raw spinach per case, 24/303
Spinach, frozen - 100 lbs. spinach per 70 lbs. frozen

Product related expenses - (other direct costs) were developed from the previously mentioned plant studies, updated and adjusted to plant types and sizes indicated and checked against performance data from industry sources. This normally included processing labor, containers, sugar and spices, power, fuel, water, and variable repairs.

Plant related expenses - (indirect costs) included management, administrative expense, selling, and other.

Depreciation - was based on 20 year life for buildings and 15 year life equipment of the estimated replacement cost of the plant. In the case of citrus, no replacement costs were available at this point so the average industry depreciation cost was used as reported by IRS in the Almanac of Business and Industrial-Financial Ratios.

Interest - for processing plants were based on indicated rates from the Almanac of Business and Industrial-Financial Ratio.

Table III-2. Estimated cash flow for frozen concentrated orange juice

| | 140 cases/hr - 144 TPD | | | 490 cases/hr - 528 TPD | | | 1,000 cases/hr - 1,072 TPD | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Annual throughput (48/6 oz) | | 400,000 | 360,000 | | 1,400,000 | 1,260,000 | | 3,000,000 | 2,700,000 |
| Sales (000) | 7.52 | 3,008 | 2,707 | 7.52 | 10,538 | 9,475 | 7.52 | 22,560 | 20,304 |
| Product related expenses (000) | 5.78 | 2,312 | 2,080 | 5.78 | 8,092 | 7,282 | 5.78 | 17,340 | 15,606 |
| Plant related expenses (000) | | 267 | 267 | | 936 | 936 | | 2,006 | 2,006 |
| Cash earnings (000) | | 429 | 360 | | 1,510 | 1,257 | | 3,214 | 2,692 |
| Depreciation 1/ (000) | | 97 | 97 | | 271 | 271 | | 474 | 474 |
| Interest (000) | | 36 | 36 | | 190 | 190 | | 406 | 406 |
| Pre-tax income (000) | | 296 | 227 | | 1,049 | 796 | | 2,334 | 1,812 |
| Income tax (000) | | 136 | 102 | | 497 | 376 | | 1,115 | 864 |
| After-tax income (000) | | 160 | 125 | | 552 | 420 | | 1,119 | 948 |
| Annual cash flow (000) | | 257 | 222 | | 823 | 691 | | 1,593 | 1,422 |
| DCF cash flow (000) | | 293 | 258 | | 1,013 | 881 | | 1,999 | 1,828 |
| Replacement investment 1/ (000) | | 1,582 | 1,582 | | 4,405 | 4,405 | | 7,694 | 7,694 |
| Total working capital (000) | | 1,002 | 901 | | 4,215 | 3,790 | | 9,024 | 8,121 |
| Total | | 2,025 | 1,924 | | 7,803 | 7,378 | | 16,718 | 15,815 |

Table III-2 (continued)

| | 140 cases/hr - 144 TPD | | | 490 cases/hr - 528 TPD | | | 1,000 cases/hr - 1,072 TPD | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Average fixed assets (000) | | 791 | 791 | | 2,202 | 2,202 | | 3,847 | 3,847 |
| Total working capital (000) | | 1,002 | 901 | | 4,215 | 3,790 | | 9,024 | 8,121 |
| Current liabilities (000) | | 644 | 579 | | 2,255 | 2,028 | | 4,828 | 4,345 |
| Average fixed investment (000) | | 1,149 | 1,113 | | 4,162 | 3,964 | | 8,043 | 7,623 |
| | | Percent | | | | | | | |
| Pre-tax income/av. fixed inv. | | 25.8 | 20.4 | | 25.2 | 20.1 | | 29.0 | 23.8 |
| Net income/av. fixed inv. | | 13.9 | 11.2 | | 13.3 | 10.6 | | 13.9 | 12.4 |
| Annual cash flow/av. fixed inv. | | 22.4 | 20.0 | | 19.8 | 17.4 | | 19.8 | 18.6 |

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[1] Preliminary

Table III-3. Estimated cash flow for single strength orange juice canning plants

| | 100 cases/hr - 54 TPD | | | 200 cases/hr - 109 TPD | | | 500 cases/hr - 272 TPD | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Annual throughput (12/46 oz. cases eq.) | | 288,000 | 259,200 | | 576,000 | 518,400 | | 1,440,000 | 1,296,000 |
| Sales (000) | 4.25 | 1,224 | 1,102 | 4.25 | 2,448 | 2,203 | 4.25 | 6,120 | 5,508 |
| Product related expenses (000) | 3.459 | 996 | 897 | | 1,992 | 1,793 | | 4,981 | 4,481 |
| Plant related expenses (000) | | 145 | 145 | | 291 | 291 | | 727 | 727 |
| Cash earnings (000) | | 82 | 60 | | 165 | 119 | | 412 | 298 |
| Depreciation (000) | | 32 | 32 | | 59 | 59 | | 129 | 129 |
| Interest (000) | | 15 | 15 | | 44 | 44 | | 110 | 110 |
| Pre-tax income (000) | | 35 | 13 | | 62 | 16 | | 173 | 59 |
| Income tax (000) | | 10 | 3 | | 23 | 4 | | 77 | 23 |
| After-tax income (000) | | 25 | 10 | | 39 | 12 | | 96 | 36 |
| Annual cash flow (000) | | 57 | 42 | | 98 | 71 | | 225 | 165 |
| DCF cash flow | | 72 | 57 | | 142 | 115 | | 335 | 275 |
| Replacement Investment[1] (000) | | 512 | 512 | | 958 | 958 | | 2,086 | 2,086 |
| Total Working Capital (000) | | 407 | 366 | | 979 | 881 | | 2,448 | 2,203 |
| Total (000) | | 919 | 878 | | 1,937 | 1,839 | | 4,534 | 4,289 |

Table III-3 (continued)

| | 100 cases/hr - 54 TPD | | | 200 cases/hr - 109 TPD | | | 500 cases/hr - 272 TPD | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Average fixed assets (000) | | 256 | 256 | | 479 | 479 | | 1,043 | 1,043 |
| Total working capital (000) | | 407 | 366 | | 979 | 881 | | 2,448 | 2,203 |
| Current liabilities (000) | | 262 | 236 | | 524 | 471 | | 1,310 | 1,179 |
| Average fixed investment (000) | | 401 | 386 | | 934 | 889 | | 2,181 | 2,067 |
| | | | | | Percent | | | | |
| Pre-tax income/av. fixed inv. | | 8.7 | 3.4 | | 6.6 | 1.8 | | 7.9 | 2.9 |
| Net income/av. fixed inv. | | 6.2 | 2.6 | | 4.2 | 1.3 | | 4.4 | 1.7 |
| Annual cash flow/av. fixed inv. | | 14.2 | 10.9 | | 10.5 | 8.0 | | 10.3 | 8.0 |

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1/ Preliminary

Table III-4. Estimated cash flow for canned apple slices

| | 200 cases/hr - 32 TPD | | | 400 cases/hr - 64 TPD | | | 600 cases/hr - 96 TPD | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Annual throughput (Cases 6/10) | | 180,000 | 162,000 | | 360,000 | 324,000 | | 540,000 | 495,000 |
| Sales (000) | 6.30 | 1,134 | 1,020 | 6.30 | 2,268 | 2,041 | 6.30 | 3,402 | 3,062 |
| Product related expenses (000) | 4.83 | 870 | 783 | 4.58 | 1,649 | 1,484 | 4.53 | 2,446 | 2,242 |
| Plant related expenses (000) | | 166 | 160 | | 270 | 270 | | 380 | 380 |
| Cash earnings (000) | | 98 | 77 | | 349 | 287 | | 576 | 440 |
| Depreciation | | | | | | | | | |
| Bldg. 5% (000) | | 26 | 26 | | 41 | 41 | | 51 | 51 |
| Equip. 6.6% (000) | | 27 | 27 | | 43 | 43 | | 63 | 63 |
| Interest (000) | | 14 | 14 | | 41 | 41 | | 61 | 61 |
| Pre-tax income (000) | | 31 | 10 | | 224 | 162 | | 401 | 265 |
| Income tax (000) | | 9 | 3 | | 102 | 72 | | 187 | 121 |
| After-tax income (000) | | 22 | 7 | | 122 | 90 | | 214 | 144 |
| Annual cash flow (000) | | 75 | 60 | | 206 | 174 | | 328 | 258 |
| DCF cash flow (000) | | 89 | 74 | | 247 | 215 | | 389 | 319 |
| Replacement investment (000) | | 918 | 918 | | 1,476 | 1,476 | | 2,076 | 2,076 |
| Total working capital (000) | | 378 | 340 | | 907 | 816 | | 1,361 | 1,225 |
| Total | | 1,286 | 1,258 | | 2,383 | 2,282 | | 3,437 | 3,301 |

continued....

Table III-4. Estimated cash flow for canned apple slices (continued)

| | 200 cases/hr - 32 TPD | | | 400 cases/hr - 64 TPD | | | 600 cases/hr - 96 TPD | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Average fixed assets (000) | | 459 | 459 | | 738 | 738 | | 1,038 | 1,038 |
| Total working capital (000) | | 378 | 340 | | 907 | 816 | | 1,361 | 1,225 |
| Current liabilities (21.4) of sales (000) | | 243 | 218 | | 485 | 437 | | 728 | 655 |
| Average fixed investment (000) | | 594 | 581 | | 1,160 | 1,117 | | 1,671 | 1,608 |
| | | | | | Percent | | | | |
| Pre-tax income/av. fixed investment | | 05.2 | 01.7 | | 19.3 | 14.5 | | 24.0 | 16.5 |
| Net income/av. fixed investment | | 03.7 | 01.2 | | 10.5 | 08.1 | | 13.3 | 09.0 |
| Annual cash flow/av. fixed investment | | 12.6 | 10.3 | | 17.8 | 15.6 | | 19.6 | 16.0 |

Table III-5. Estimated cash flow for canned apple sauce plants

| | Small 32 TPD | | | Medium - 64 TPD | | | Large - 96 TPD | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Annual throughput | | | | | | | | | |
| 6/10s | | 60,000 | 54,000 | | 120,000 | 108,000 | | 180,000 | 162,000 |
| | | 290,250 | 261,225 | | 580,500 | 522,450 | | 870,750 | 783,675 |
| Sales (25% 6/10s) | 5.13 | 308 | 277 | 5.13 | 616 | 554 | 5.13 | 923 | 831 |
| (75% 303s) | 3.62 | 1,051 | 946 | 3.62 | 2,101 | 1,891 | 3.62 | 3,152 | 2,837 |
| Total sales (000) | | 1,359 | 1,223 | | 2,717 | 2,445 | | 4,075 | 3,668 |
| Product related expenses (000) | | 1,072 | 965 | | 2,061 | 1,855 | | 3,096 | 2,786 |
| Plant related expenses expenses (000) | | 183 | 183 | | 306 | 306 | | 434 | 434 |
| Cash earnings (000) | | 104 | 75 | | 350 | 284 | | 545 | 448 |
| Depreciation (000) | | | | | | | | | |
| Bldg. (5%) | | 26 | 26 | | 30 | 30 | | 59 | 59 |
| Equip. (6.6%) | | 27 | 27 | | 43 | 43 | | 62 | 62 |
| Interest (000) | | 16 | 16 | | 49 | 49 | | 73 | 73 |
| Pre-tax income (000) | | 35 | 6 | | 228 | 162 | | 351 | 254 |
| Income tax | | 11 | 2 | | 104 | 72 | | 163 | 116 |
| After-tax income (000) | | 24 | 4 | | 124 | 90 | | 188 | 138 |
| Annual cash flow | | 77 | 57 | | 197 | 163 | | 309 | 259 |
| DCF Cash Flow | | 93 | 73 | | 246 | 212 | | 382 | 332 |
| Replacement Investment (000) | | 928 | 928 | | 1,250 | 1,250 | | 2,120 | 2,120 |
| Total Working Capital | | 453 | 408 | | 906 | 815 | | 1,358 | 1,222 |
| Total | | 1,381 | 1,336 | | 2,156 | 2,065 | | 3,478 | 3,342 |

Table III-5 (continued)

| | Small - 32 TPD | | | Medium - 64 TPD | | | Large - 96 TPD | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Average fixed assets (000) | | 464 | 464 | | 625 | 625 | | 1,060 | 1,060 |
| Total Working Capital (000) | | 453 | 408 | | 406 | 815 | | 1, 358 | 1,222 |
| Current Liabilities (21.4) of sales (000) | | 291 | 202 | | 581 | 523 | | 872 | 785 |
| Average fixed investment (000) | | 626 | 610 | | 950 | 917 | | 1, 546 | 1,497 |
| | | | | Percent | | | | | |
| Pre-tax income/av. fixed investment | | 5.6 | 1.0 | | 24.0 | 17.7 | | 22.7 | 17.0 |
| Net income/av. fixed investment | | 3.8 | .7 | | 13.0 | 9.8 | | 12.2 | 9.2 |
| Annual cash flow/av. fixed investment | | 12.3 | 9.3 | | 20.7 | 17.8 | | 20.0 | 17.3 |

Table III-6. Estimated cash flow for canned apple juice plants

| | 218 cases/hr - 48 TPD | | | 435 cases/hr - 96 TPD | | | 653 cases/hr - 144 TPD | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Annual Throughput (12/3) | | 196,000 | 176,400 | | 392,000 | 352,800 | | 588,000 | 529,200 |
| Sales (000) | 3.60 | 705 | 635 | 3.60 | 1,411 | 1.270 | 3.60 | 2,116 | 1,905 |
| Product Related Expenses (000) | 2.50 | 490 | 441 | 2.30 | 900 | 811 | 2.29 | 1,346 | 1,211 |
| Plant Related Expenses (000) | | 135 | 135 | | 210 | 210 | | 289 | 289 |
| Cash Earnings (000) | | 80 | 59 | | 301 | 249 | | 481 | 405 |
| Depreciation (000) | | | | | | | | | |
| Bldg. (5%) (000) | | 9 | 9 | | 15 | 15 | | 22 | 22 |
| Equip. (6.6%) (000) | | 13 | 13 | | 15 | 15 | | 21 | 21 |
| Interest (000) | | 8 | 8 | | 25 | 25 | | 38 | 38 |
| Pre-tax Income (000) | | 50 | 29 | | 246 | 194 | | 400 | 324 |
| Income Tax (000) | | 18 | 8 | | 112 | 87 | | 186 | 149 |
| After-tax income (000) | | 32 | 21 | | 134 | 107 | | 214 | 175 |
| Annual cash flow (000) | | 54 | 43 | | 164 | 137 | | 257 | 218 |
| DCF cash flow | | 62 | 51 | | 189 | 162 | | 295 | 256 |
| Replacement investment (000) | | 395 | 395 | | 540 | 540 | | 740 | 740 |
| Total working capital (000) | | 234 | 211 | | 564 | 508 | | 846 | 762 |
| Total (000) | | 629 | 606 | | 1,104 | 1,048 | | 1,586 | 1,502 |

continued ....

Table III-6 (continued)

| | 218 cases/hr - 48 TPD | | | 435 cases/hr - 96 TPD | | | 653 cases/hr - 144 TPD | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Average fixed assets (000) | | 198 | 198 | | 270 | 270 | | 370 | 370 |
| Total working capital | | 234 | 211 | | 564 | 508 | | 846 | 762 |
| Current liabilities (21.4) (000) | | 151 | 136 | | 302 | 271 | | 453 | 407 |
| Average fixed investment (000) | | 281 | 273 | | 532 | 507 | | 763 | 725 |
| | | | | | Percent | | | | |
| Pre-tax income/ave. fixed investment | | 17.8 | 10.6 | | 46.2 | 38.3 | | 52.4 | 44.7 |
| Net income/av. fixed investment | | 11.4 | 7.6 | | 25.1 | 21.1 | | 28.0 | 24.1 |
| Annual cash flow/av. fixed investment | | 19.2 | 15.8 | | 30.8 | 27.0 | | 33.6 | 30.1 |

Table III-7. Estimated cash flow for frozen apple slices plant

| | 9,600 lbs. per hour | | | 19,200 lbs. per hour | | | 28,800 lbs. per hour | | |
|---|---|---|---|---|---|---|---|---|---|
| | $/lb. | Annual | Annual | $/lb. | Annual | Annual | $/lb. | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Annual throughput (000 lb) | | 8,640 | 7,776 | | 17,280 | 15,552 | | 25,920 | 23,328 |
| Sales (000) | .151 | 1,305 | 1,174 | .151 | 2,609 | 2,348 | .151 | 3,913 | 3,522 |
| Product related expenses (000) | .153 | 1,326 | 1,193 | .149 | 2,581 | 2,323 | .148 | 3,849 | 3,464 |
| Plant related expenses (000) | | 179 | 179 | | 297 | 297 | | 421 | 421 |
| Cash earnings (000) | | -200 | -198 | | -269 | -272 | | -357 | -363 |
| Depreciation (000) | | | | | | | | | |
| Bldg. (5%) | | 47 | 47 | | 81 | 81 | | 113 | 113 |
| Equip. (6.6%) | | 18 | 18 | | 24 | 24 | | 46 | 46 |
| Interest (000) | | 16 | 16 | | 31 | 31 | | 47 | 47 |
| Pre-tax income (000) | | -281 | -279 | | -405 | -408 | | -563 | -569 |
| Income tax | | -- | -- | | -- | -- | | -- | -- |
| After-tax income (000) | | -281 | -279 | | -405 | -408 | | -563 | -569 |
| Annual cash flow (000) | | -216 | -214 | | -300 | -303 | | -404 | -410 |
| DCF cash flow | | -200 | -198 | | -269 | -272 | | -451 | -457 |
| Replacement investment (000) | | 1,219 | 1,219 | | 2,117 | 2,117 | | 3,972 | 3,972 |
| Total working capital (000) | | 435 | 391 | | 1,043 | 939 | | 1,565 | 1,409 |
| Total (000) | | 1,654 | 1,610 | | 3,160 | 3,056 | | 5,537 | 5,381 |

continued.....

Table III-7. Estimated cash flow for frozen apple slices plant (continued)

| | 9,600 lbs. per hour | | | 19,200 lbs. per hour | | | 28,800 lbs. per hour | | |
|---|---|---|---|---|---|---|---|---|---|
| | $/lb. | Annual | Annual | $/lb. | Annual | Annual | $/lb. | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Average fixed assets (000) | | 605 | 605 | | 1,059 | 1,059 | | 1,986 | 1,986 |
| Total working capital (000) | | 435 | 391 | | 1,043 | 939 | | 1,556 | 1,409 |
| Current liabilities (21.4 of sales) (000) | | 279 | 251 | | 558 | 502 | | 837 | 754 |
| Average fixed investment (000) | | 761 | 745 | | 1,544 | 1,496 | | 2,705 | 2,541 |
| | | | | | Percent | | | | |
| Pre-tax income/av. fixed investment | | ( ) | ( ) | | ( ) | ( ) | | ( ) | ( ) |
| Net income/av. fixed investment | | ( ) | ( ) | | ( ) | ( ) | | ( ) | ( ) |
| Annual cash flow/av. fixed investment | | ( ) | ( ) | | ( ) | ( ) | | ( ) | ( ) |

Table III-8. Estimated cash flow for spinach canning plant

| | 100 case/hr. | | | 400 case/hr. | | | 1,200 case/hr. | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Annual Throughput (Cases) | | 50,000 | 45,000 | | 200,000 | 180,000 | | 600,000 | 540,000 |
| Sales ($1,000) | 3.65 | 183,000 | 164,000 | 3.65 | 730,000 | 657,000 | 3.65 | 2,190,000 | 1,971,000 |
| Operating Expenses | | 171,000 | 162,000 | | 607,000 | 567,000 | | 1,567,000 | 1,484,000 |
| Cash Earnings | | 12,000 | 2,000 | | 123,000 | 90,000 | | 623,000 | 487,000 |
| Depreciation | | | | | | | | | |
| Bldg. at 5% | | 2,250 | 2,250 | | 6,100 | 6,100 | | 16,200 | 16,200 |
| Equip. at 6.6% | | 4,440 | 4,440 | | 10,974 | 10,974 | | 26,255 | 26,255 |
| Interest | | 1,830 | 1,830 | | 8,760 | 8,760 | | 39,420 | 39,420 |
| Pre-tax Income | | 3,480 | -6,520 | | 97,166 | 64,166 | | 541,125 | 405,125 |
| Income tax | | 870 | - | | 40,890 | 15,050 | | 253,990 | 188,710 |
| After-tax Income | | 2,610 | -6,520 | | 56,276 | 49,116 | | 287,135 | 216,415 |
| Annual cash flow | | 9,300 | 170 | | 73,350 | 66,190 | | 329,590 | 258,870 |
| DCF cash flow | | 11,130 | 2,000 | | 82,110 | 74,950 | | 369,010 | 298,290 |
| Replacement investment | | 122,303 | 122,303 | | 307,487 | 307,487 | | 781,711 | 781,711 |
| Total working capital | | 60,900 | 54,600 | | 292,000 | 262,800 | | 876,000 | 788,400 |
| Total | | 183,203 | 176,903 | | 599,487 | 570,287 | | 1,657,711 | 1,570,111 |

continued.....

Table III-8. Estimated cash flow for spinach canning plant (continued)

| | 100 case/hr. | | | 400 case/hr. | | | 1,200 case/hr. | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ Case | Annual | Annual | $ Case | Annual | Annual | $ Case | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Average fixed assets | | 61,152 | 61,152 | | 153,744 | 153,744 | | 390,856 | 390,856 |
| Total working capital | | 60,900 | 54,600 | | 292,000 | 262,800 | | 876,000 | 788,400 |
| Current liabilities (21.4 of sales) | | 39,000 | 35,000 | | 156,000 | 141,000 | | 469,000 | 422,000 |
| Average fixed investment | | 83,052 | 80,752 | | 289,744 | 275,544 | | 797,856 | 757,256 |
| | Percent | | | | | | | | |
| Pre-tax income/av. fixed investment | | 04.2 | ( ) | | 33.5 | 23.2 | | 67.8 | 53.5 |
| Net income/av. fixed investment | | 03.1 | ( ) | | 19.4 | 17.8 | | 36.0 | 28.6 |
| Annual cash flow/av. fixed investment | | 11.2 | 00.2 | | 25.3 | 24.0 | | 41.3 | 34.2 |

Table III-9. Estimated cash flow for spinach freezing plant

| | 1,500 lbs. per hour | | | 6,000 lbs. per hour | | | 22,500 lbs. per hour | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ lb. | Annual | Annual | $ lb. | Annual | Annual | $ lb. | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Annual Throughput (lbs) | | 750,000 | 675,000 | | 3,000,000 | 2,700,000 | | 11,250,000 | 10,125,000 |
| Sales | .1856 | 139,200 | 125,280 | .1856 | 556,800 | 501,120 | .1856 | 2,088,000 | 1,879,200 |
| Product related expenses | .0996 | 74,700 | 67,230 | .1855 | 256,500 | 230,850 | .0595 | 669,375 | 602,437 |
| Plant related expenses | | 90,696 | 90,696 | | 274,500 | 274,500 | | 937,634 | 937,634 |
| Cash earnings | | -26,196 | -32,646 | | 25,800 | -4,230 | | 480,991 | 339,129 |
| Depreciation | | | | | | | | | |
| Bldg. at 5% | | 826 | 826 | | 1,991 | 1,991 | | 5,212 | 5,212 |
| Equip. at 6.6% | | 2,544 | 2,544 | | 6,134 | 6,123 | | 16,978 | 16,978 |
| Interest | | 1,392 | 1,392 | | 6,681 | 6,681 | | 20,250 | 20,250 |
| Pre-tax income | | -30,968 | -37,408 | | 10,994 | -19,036 | | 438,551 | 296,689 |
| Income tax | | -- | -- | | 2,748 | | | 204,754 | 136,661 |
| After-tax income | | -30,968 | -37,408 | | 8,246 | -19,036 | | 233,797 | 160,028 |
| Annual cash flow | | -27,598 | -34,038 | | 16,371 | -10,911 | | 255,987 | 182,218 |
| DCF cash flow | | -26,206 | -32,646 | | 25,800 | - 4,230 | | 480,099 | 196,719 |
| Replacement investment | | 551,000 | 551,000 | | 1,328,000 | 1,328,000 | | 3,675,000 | 3,675,000 |
| Total working capital | | 46,000 | 42,000 | | 222,000 | 200,000 | | 835,000 | 752,000 |
| Total | | 597,000 | 593,000 | | 1,550,000 | 1,528,000 | | 4,510,000 | 4,427,000 |

continued....

Table III-9. Estimated cash flow for spinach freezing plant (continued)

| | 1,500 lbs. per hour | | | 6,000 lbs. per hour | | | 22,500 lbs. per hour | | |
|---|---|---|---|---|---|---|---|---|---|
| | $ lb. | Annual | Annual | $ lb. | Annual | Annual | $ lb. | Annual | Annual |
| Utilization | | 100 | 90 | | 100 | 90 | | 100 | 90 |
| Average fixed assets | | 275,500 | 275,500 | | 664,000 | 664,000 | | 1,837,500 | 1,837,500 |
| Total working capital | | 46,000 | 42,000 | | 222,000 | 200,000 | | 835,000 | 752,000 |
| Current liabilities (21.4 of sales) | | 30,000 | 27,000 | | 119,000 | 107,000 | | 447,000 | 402,000 |
| Average fixed investment | | 291,500 | 290,500 | | 767,000 | 757,000 | | 2,225,500 | 2,187,500 |
| | Percent | | | | | | | | |
| Pre-tax income/av. fixed investment | | ( ) | ( ) | | 01.4 | ( ) | | 19.7 | 13.6 |
| Net income/av. fixed investment | | ( ) | ( ) | | 01.1 | ( ) | | 10.5 | 07.3 |
| Annual cash flow/av. investment | | ( ) | ( ) | | 02.1 | ( ) | | 11.5 | 08.3 |

## 3. Summary of Model Plant Data

Model plant sales, variable costs, fixed costs including depreciation and interest are summarized in Table III-10. The summary is made at the 90 percent utilization level as this will present a more realistic operating value than the hypothetical 100 percent.

Raw product cost ranges from a low of 10 percent for the spinach canning plant (slight variation due to rounding) to a high of 55 percent for frozen concentrated orange juice.

As a check of the accuracy of the model plant data, a comparison was made with margin data developed by ERS of USDA.[1] Generally, processor margins are expanding over time and the most current ERS estimate is for 1969/70 so some variation can be expected. A summary of the results is as follows:

| | Processor Margins | |
|---|---|---|
| | Model Plants | USDA |
| Frozen Orange Juice | 55% | 53% |
| Canned SS OJ | 44 | 42 |
| Applesauce, canned | 31 | 28 |
| Canned spinach | 11 | 11 |
| Frozen spinach | 19 | 17 |

This brief description indicates that the revenue and raw product calculation in the model plants accurately reflect the cost relationships that exists in the industry.

The breakdown of processing costs to other direct and indirect costs is somewhat arbitrary and does not provide a meaningful comparison between plants. The two should be summed. On that basis, they range from a low of 32 percent for frozen orange juice to a high of 77 percent for canned spinach. This range is to be expected given existing raw product margin.

As indicated previously, depreciation was calculated on the basis of replacement cost and ranged from 1 to 5 percent of sales as expected. This is slightly higher than actual industry averages which ranged from 2.1 to 2.3 percent of sales for the years 67-68 through 69-70.

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[1] Economic Research Service, "Prices, Margin and F rm Value for Canned and Frozen Fruits, Vegetables and Juices," Statistical Bulletin No. 420, USDA, 1971.

Table III-10. Estimated sales, variable and fixed costs and relationships for industry segments based on model plants (90 percent utilization)

| | | | Sales | | Variable costs | | | | Fixed Costs | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Raw materials | | Other direct | | Indirect | | Depreciation | | Interest | | | |
| | Unit | Capacity | Dollars | Percent of sales | Dollars | Percent of sales | Dollars | Percent of sales | Dollars | Percent of sales | Dollars | Percent of sales | Dollars | Percent of sales | Dollars | Percent of sales |
| OJ, frozen conc. | 48/6 | 400 | 2,707 | 100.0 | 1,483 | 54.78 | 597 | 22.05 | 267 | 9.86 | 97 | 3.58 | 36 | 1.20 | 2,480 | 91.61 |
| " | oz. | 1,400 | 9,475 | 100.0 | 5,191 | 54.83 | 2,091 | 22.07 | 936 | 9.88 | 271 | 2.86 | 190 | 2.01 | 8,679 | 91.60 |
| " | | 3,000 | 20,304 | 100.0 | 11,124 | 54.79 | 4,482 | 22.07 | 2,006 | 9.88 | 474 | 2.33 | 406 | 2.00 | 18,492 | 91.08 |
| OJ, SS canned | 12/48 | 288 | 1,102 | 100.0 | 488 | 44.28 | 411 | 37.30 | 145 | 13.16 | 32 | 2.90 | 15 | 1.36 | 1,091 | 99.00 |
| " | | 576 | 2,203 | 100.0 | 976 | 44.30 | 617 | 37.09 | 291 | 13.21 | 59 | 2.68 | 44 | 2.00 | 2,187 | 99.27 |
| " | | 1,440 | 5,508 | 100.0 | 2,440 | 44.30 | 2,041 | 37.06 | 727 | 13.20 | 129 | 2.34 | 110 | 2.00 | 5,447 | 98.89 |
| Apple slices, canned | 6/10 | 180 | 1,020 | 100.0 | 378 | 37.06 | 405 | 39.71 | 166 | 16.27 | 53 | 5.20 | 14 | 1.37 | 1,016 | 99.61 |
| " | | 360 | 2,041 | 100.0 | 758 | 37.14 | 726 | 35.62 | 270 | 13.23 | 84 | 4.12 | 41 | 2.01 | 1,879 | 92.06 |
| " | | 540 | 3,062 | 100.0 | 1,137 | 37.13 | 1,105 | 36.09 | 380 | 12.41 | 114 | 3.72 | 61 | 1.99 | 2,797 | 91.35 |
| Apple sauce, canned | 303 eq. | 387 | 1,223 | 100.0 | 379 | 31.00 | 586 | 47.91 | 183 | 14.96 | 53 | 4.33 | 16 | 1.31 | 1,217 | 99.51 |
| " | | 774 | 2,445 | 100.0 | 758 | 31.00 | 1,097 | 44.87 | 306 | 12.52 | 73 | 2.99 | 49 | 2.00 | 2,283 | 93.37 |
| " | | 1,162 | 3,668 | 100.0 | 1,137 | 31.00 | 1,649 | 44.99 | 434 | 11.83 | 121 | 3.30 | 73 | 1.99 | 3,414 | 93.08 |
| Apple juice canned | 12/3 | 192 | 635 | 100.0 | 156 | 24.57 | 285 | 44.88 | 135 | 21.26 | 22 | 3.46 | 8 | 1.26 | 606 | 95.43 |
| " | | 392 | 1,270 | 100.0 | 311 | 24.49 | 500 | 39.37 | 210 | 16.54 | 30 | 2.36 | 25 | 1.97 | 1,076 | 84.72 |
| " | | 588 | 1,905 | 100.0 | 467 | 24.51 | 744 | 39.06 | 289 | 15.17 | 43 | 2.26 | 38 | 1.99 | 1,581 | 82.99 |
| | | | | 100.0 | | | | | | | | | | | | |
| Apple slices frozen | lb. | 8,640 | 1,174 | 100.0 | 379 | 32.28 | 814 | 69.34 | 179 | 15.25 | 65 | 5.54 | 16 | 1.36 | 1,453 | 123.76 |
| " | | 17,280 | 2,348 | 100.0 | 758 | 32.28 | 1,567 | 66.74 | 297 | 12.65 | 115 | 4.90 | 31 | 1.32 | 2,768 | 117.89 |
| " | | 25,920 | 3,522 | 100.0 | 1,137 | 32.28 | 2,327 | 66.07 | 421 | 11.95 | 169 | 4.80 | 47 | 1.33 | 4,101 | 116.44 |
| Spinach canned | 303 | 50 | 183 | 100.0 | 18 | 9.84 | 144 | 78.69 | 1/ | | 7 | 3.83 | 2 | 1.09 | 171 | 93.44 |
| " | | 200 | 657 | 100.0 | 74 | 11.26 | 493 | 75.04 | 1/ | | 17 | 2.59 | 9 | 1.37 | 593 | 90.26 |
| " | | 600 | 1,971 | 100.0 | 220 | 11.16 | 1,264 | 64.13 | 1/ | | 42 | 2.13 | 39 | 1.98 | 1,565 | 79.40 |
| Spinach frozen | lb. | 750 | 125 | 100.0 | 24 | 19.20 | 43 | 34.40 | 91 | 72.80 | 4 | 3.20 | 2 | 1.60 | 164 | 131 20 |
| " | | 3,000 | 501 | 100.0 | 97 | 19.36 | 134 | 26.75 | 275 | 54.89 | 8 | 1.60 | 7 | 1.40 | 521 | 103.99 |
| " | | 11,250 | 2,088 | 100.0 | 361 | 17.29 | 241 | 11.54 | 938 | 44.92 | 21 | 1.01 | 20 | .95 | 1,581 | 75.72 |

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1/ Combined with other direct

Interest rates were taken from IRS averages. Net profits as a percent of net sales are summarized for the model plants in Table III-11. Net profits range from < 0 to as high as 11 percent for canned spinach. A sample average of sales to net profit for the small plants is 1.6 percent, for medium plants, 4.5 percent and 5.6 percent for large plants. This compares with the industry average of 4.0 percent during the period from 1915-1917 and is slightly higher than the latest information available from published IRS data which averaged 3.2% for 1967-68, 2.6% for 1968-69 and 2.2% for 1969-70.

4. Annual Profit before Taxes

Pre-tax income, return on average invested capital before and after taxes and after tax return on sales, for the types and sizes of fruit and vegetable packing plants analyzed, are shown in Table III-11.

Pre-tax income was derived as follows:

Gross sales
\- Raw materials cost
= Gross margin
\- Direct and indirect operating expenses
= Cash earnings
\- Depreciation and interest
= Pre-tax income

These data were developed from a combination of published and unpublished sources and were checked against available information on industry financial ratios and other measures of industry financial performance, to insure their credibility.

Average invested capital was calculated as follows:

Average fixed assets (1/2 of replacement cost)
\+ Total working capital
\- Current liabilities
= Average invested capital

Average fixed assets were estimated from previously published research (updated and adjusted for plant size and type), enginnering estimates of plant and equipment and industry information on new plant costs. These estimates are still in the process of being checked by knowledgeable individuals in the food industry.

Current liabilities were estimated from industry performance ratios as reported in the Almanac of Business and Industrial Financial Ratios--1973. The uniform rate used for all plants was the three year industry average of 21.4 percent of sales.

Table III-11. Estimated pre-tax income and rate of return on average invested capital for industry segments based on model plants.

| | | | Pre-tax Income Dollars | | ROI Pre-tax Income | | ROI After Tax Income | |
|---|---|---|---|---|---|---|---|---|
| | | Season | Utilization | | Utilization | | Utilization | |
| Plant | Unit | Capacity | 100% | 90% | 100% | 90% | 100% | 90% |
| | | (000) | | | | | | |
| Orange juice. frozen conc. | 48/6 oz. | 400 | 296 | 227 | 25.8 | 20.4 | 13.9 | 11.2 |
| " | | 1,400 | 1,049 | 796 | 25.2 | 20.1 | 13.3 | 10.6 |
| " | | 3,000 | 2,334 | 1,812 | 29.0 | 23.8 | 13.9 | 12.4 |
| Orange juice, ss canned | 12/46 oz. | 288 | 35 | 13 | 8.7 | 3.4 | 6.2 | 2.6 |
| " | | 576 | 62 | 16 | 6.6 | 1.8 | 4.2 | 1.3 |
| " | | 1,440 | 173 | 59 | 7.9 | 2.9 | 4.4 | 1.7 |
| Apple slices, canned | 6/10 | 180 | 31 | 10 | 5.2 | 1.7 | 3.7 | 1.2 |
| " | | 360 | 224 | 162 | 19.3 | 14.5 | 10.5 | 8.1 |
| " | | 540 | 401 | 265 | 24.0 | 16.5 | 13.3 | 9.0 |
| Apple sauce, canned | 303 | 387 | 35 | 6 | 5.6 | 1.0 | 3.8 | 0.7 |
| " | | 774 | 228 | 162 | 24.0 | 17.7 | 13.0 | 9.8 |
| " | | 1,162 | 351 | 254 | 22.7 | 17.0 | 12.2 | 9.2 |
| Apple juice, canned | 12/3 | 196 | 50 | 29 | 17.8 | 10.6 | 11.3 | 7.8 |
| " | | 392 | 246 | 194 | 46.2 | 38.3 | 25.2 | 18.2 |
| " | | 588 | 400 | 324 | 52.4 | 44.6 | 28.0 | 24.1 |
| Apple slices, frozen | lbs. | 8,640 | (281) | (279) | 0 | 0 | 0 | 0 |
| " | | 17,280 | (405) | (408) | 0 | 0 | 0 | 0 |
| " | | 25,920 | (563) | (569) | 0 | 0 | 0 | 0 |

Table III-11. (Cont'd)

| | | | Pre-tax Income Dollars | | ROI Pre-tax Income | | ROI After Tax Income | |
|---|---|---|---|---|---|---|---|---|
| | | Season | Utilization | | Utilization | | Utilization | |
| Plant | Unit | Capacity | 100% | 90% | 100% | 90% | 100% | 90% |
| Spinach, canning | 303 | 50 | 3 | (6) | 3.6 | 0 | 3.1 | 0 |
| " | | 200 | 97 | 64 | 33.5 | 23.3 | 19.3 | 17.8 |
| " | | 600 | 541 | 405 | 67.8 | 53.5 | 36.0 | 28.5 |
| Spinach, frozen | lb. | 750 | (31) | (37) | 0 | 0 | 0 | 0 |
| " | | 3,000 | 11 | (19) | 1.4 | 0 | 0.4 | 0 |
| " | | 11,250 | 438 | 296 | 19.7 | 13.5 | 10.5 | 7.3 |

Table III-12 Estimated annual cash flow and rate of return on average invested capital for industry segments based on model plants.

| | | | Annual Cash Flow Dollars | | ROI Annual Cash Flow | |
|---|---|---|---|---|---|---|
| | | | Utilization | | Utilization | |
| Plant | Unit | Capacity | 100% | 90% | 100% | 90% |
| | | (000) | | | (Percent) | |
| Orange juice, frozen conc. | 48/6 oz. | 400 | 257 | 222 | 22.4 | 20.0 |
| " | | 1,400 | 823 | 691 | 19.8 | 17.4 |
| " | | 3,000 | 1,593 | 1,422 | 19.8 | 18.6 |
| Orange juice, ss canned | 12/46 oz. | 288 | 57 | 42 | 14.2 | 10.9 |
| " | | 576 | 98 | 71 | 10.5 | 8.0 |
| " | | 1,440 | 225 | 165 | 10.3 | 8.0 |
| Apple slices, canned | 6/10 | 180 | 75 | 60 | 12.6 | 11.8 |
| " | | 360 | 206 | 174 | 17.8 | 15.6 |
| " | | 540 | 328 | 258 | 19.6 | 16.0 |
| Apple sauce, canned | 303 | 387 | 77 | 57 | 12.3 | 9.3 |
| " | | 774 | 197 | 163 | 20.7 | 17.8 |
| " | | 1,162 | 309 | 259 | 20.0 | 17.3 |
| Apple juice, canned | 12/3 | 196 | 54 | 43 | 19.2 | 15.8 |
| " | | 392 | 164 | 137 | 30.8 | 27.0 |
| " | | 588 | 257 | 219 | 33.6 | 30.1 |
| Apple slices, frozen | lbs. | 8,640 | (216) | (214) | 0 | 0 |
| " | | 17,280 | (300) | (303) | 0 | 0 |
| " | | 25,920 | (404) | (410) | 0 | 0 |

Table III-12 (continued)

| | | | Annual Cash Flow Dollars | | ROI Annual Cash Flow | |
|---|---|---|---|---|---|---|
| | | | Utilization | | Utilization | |
| Plant | Unit | Capacity | 100% | 90% | 100% | 90% |
| Spinach, canning | 303 | 50 | 9 | 1 | 11.2 | 0.2 |
| " | | 200 | 73 | 66 | 25.3 | 24.0 |
| " | | 600 | 330 | 259 | 41.3 | 34.2 |
| Spinach, frozen | lbs. | 750 | (28) | (34) | 0 | 0 |
| " | | 3,000 | 16 | (10) | 2.1 | 0 |
| " | | 11,250 | 255 | 182 | 11.5 | 8.3 |

Working capital was estimated from actual industry performance ratios as reported from IRS data in the Almanac of Business and Industrial Financial Ratios. In the earlier study for EPA by DPRA, working capital was estimated at 33.3 percent of sales. The IRS data confirmed this level of working capital for small plants but for medium and large plants, the level as a percentage of sales was increased to 40 percent.

Pre-tax returns on average capital varied directly with size of plant with the exception of the citrus industry (discussed below). This ranged from a negative return for all sizes of frozen apple plants to a high of 53 percent for the large spinach canning plant at the 90 percent level of utilization.

As expected, orange juice frozen concentrate demonstrated a higher rate of profit than did canned SS. A uniform operating cost was used for all size plants in the citrus industry as direct industry results indicate no direct relation between cost of processing and size of operation.

Low returns were obtained on both the frozen apple and frozen spinach plants. This can generally be explained by the high cost of investment per case of operating capacity. In order for freezing plants to operate profitability they must pack for longer seasons and maintain higher annual throughputs per unit of capacity. For this reason, nearly all freezing plants extend their operating season with the addition of other products to their processing limit.

### 5. Annual Cashflow

The estimated annual cashflow and rate of return on average capital for model plants is shown in Table III-12. Based on the 90 percent utilization figure, percent return by plant averaged between 8 and 34 percent with the exception of the non-citrus freezing plants which remain either negative or very low. Again economies of scale for size of plant are evident (with the exception noted above).

### 6. Market Value of Assets

The market or salvage value of processing plants will vary widely from plant to plant depending on the age of the plant, type and equipment configuration. Also the condition of plant and equipment, and location will effect the market or salvage value.

Where plants are forced to close because they are presently unprofitable, or because they would become unprofitable if they were forced to assume the added investments and operating costs required for water pollution control, then the salvage value of some buildings would be essentially zero. Storage areas could be converted to alternative uses and the equipment might sell from 10 to 50 percent of its original cost and the value of the site could vary widely, depending on location.

In many instances, the value of a plant, particularly where a small firm is involved, would be greater to its present owner than it would be to any potential buyer. In terms of "book value", the physical facilities and equipment may have been fully depreciated, or nearly so, but in terms of their "use value" to their present owners, these plants represent assets with tangible values--much greater than their market or their salvage value.

No data were available on actual salvage values for fruit and vegetable plants. A "market" for plants which would be forced to close, because of added costs of water pollution control, would be virtually non-existent. The impact analysis will therefore use an arbitrary ascribed value for salvage value.

All operating capital will be recovered intact, land will be valued at its original cost and buildings and equipment will be valued at 10 percent of their replacement value. The combined value of operating capital, land, buildings, and equipment will represent the salvage value to be used.

Table III-13. Estimated replacement value and gross working capital requirements for industry segments based on model plants

| Type and Size | Replacement value of plant equipment & site ($000) | Total working capital requirement ($000) | Replacement value of total assets ($000) |
|---|---|---|---|
| Frozen OJ Conc. | | | |
| Small | 1,023 | 1,002 | 2,025 |
| Medium | 3,588 | 4,215 | 7,803 |
| Large | 7,694 | 9,024 | 16,718 |
| Canned SS orange | | | |
| Small | 417 | 407 | 824 |
| Medium | 835 | 979 | 1,814 |
| Large | 2,086 | 2,448 | 4,534 |
| Apple slices canned | | | |
| Small | 918 | 378 | 1,286 |
| Medium | 1,476 | 907 | 2,383 |
| Large | 2,076 | 1,361 | 3,437 |
| Apple sauce canned | | | |
| Small | 395 | 234 | 629 |
| Medium | 540 | 564 | 1,104 |
| Large | 740 | 846 | 1,586 |
| Apple juice canned | | | |
| Small | 931 | 452 | 1,383 |
| Medium | 1,508 | 1,087 | 2,595 |
| Large | 2,109 | 1,630 | 3,739 |
| Apple slices frozen | | | |
| Small | 1,219 | 435 | 1,654 |
| Medium | 2,117 | 1,043 | 3,160 |
| Large | 3,972 | 1,565 | 5,537 |
| Spinach canned | | | |
| Small | 122 | 61 | 183 |
| Medium | 307 | 292 | 599 |
| Large | 781 | 876 | 1,657 |
| Spinach frozen | | | |
| Small | 551 | 46 | 597 |
| Medium | 1,328 | 222 | 1,550 |
| Large | 3,675 | 835 | 4,510 |

## C. Comparison of Model Plant Data with IRS Data

Selected financial data and asset size for firms in canned and frozen foods is given in Table III-14. This is based on the latest available 3 year results from the Almanac of Business and Industrial Ratios as developed from IRS data.

Net income as a percent of sales as derived from the industry averages amounted to 3.6 percent in 67-68, 2.3 percent in 1968-69 and 1.8 in 1969 and 1970. Considerable variation was experienced by size of firm wit with the very small firm (less than $50,000 of asset) performing relatively well. A sharp drop in profits for the next size category with a gradual increase in profits as the firm size increases. The relatively high profits of the very small firms may be explained by older plants with large amounts of plant and equipment already depreciated out, low wages for production line workers and relatively low level management structure model plants. Model plants, however, show a higher net income averaging 1.6 percent for small plants, 4.5 percent for medium and 5.6 percent for large plants. (Table III-11). However, other costs such as management, advertising and G and A may be understated on the model plants.

Net Income as a Percent of Total Assets Less Current Liabilities. For the total industry this was reported at a high of 7.2 in 1967-68 and decreased gradually to 5.0 in 1969-70. There are great variations by plant size with some of the small plants sizes showing returns up to 51 percent. The results generally decrease as plant sizes become larger.

The model plant data as presented in Section III-B-2 ranged from less than 0 to a high of 36 percent -- averaging somewhat higher than the actual industry averages. Model plant data with the exception of citrus, demonstrated definite economies of scale with large plants demonstrating higher returns. Frozen orange juice ranged from 12 to 16 percent, canned orange juice from 1 to 2 percent and canned apples and apple sauce from 1 to 24 percent. Canned apple juice ranked similar to

Table III- 14. Selected financial data for firms in canned and frozen foods by asset size

| | Total | Under 50 | 50-100 | 100-250 | 250-500 | 500-1,000 | 1,000-5,000 | 5,000-10,000 | 10,000-25,000 | 25,000-50,000 | 50,000-100,000 | 100,000-250,000 | 250,000-& over |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of Firms reporting | | | | | | | | | | | | | |
| 1967-68 | 1,805 | 24.3 | 9.4 | 19.9 | 13.0 | 11.9 | 16.0 | 2.9 | 1.4 | 0.5 | 0.1 | 0.2 | 0.2 |
| 1968-69 | 1,588 | 22.5 | 13.1 | 8.3 | 11.1 | 19.6 | 15.5 | 6.0 | 2.3 | .5 | .3 | .5 | |
| 1969-70 | 1,707 | 15.8 | 18.7 | 18.6 | 12.0 | 18.9 | 9.9 | 17.4 | 3.0 | 2.4 | .7 | .5 | |
| Net Income before tax as a percent of labor | | | | | | | | | | | | | |
| 1967-68 | 3.6 | - | - | * | * | 2.2 | 3.0 | 4.5 | 3.4 | 3.2 | * | 4.4 | 6.0 |
| 1968-69 | 2.3 | 2.9 | 9.0 | - | .6 | 1.6 | - | * | 2.6 | 2.1 | * | 4.6 | N/C |
| 1969-70 | 1.8 | .7 | * | * | * | 2.4 | - | 2.1 | 1.9 | 1.9 | .5 | 3.2 | N/C |
| Net Income or percent of total assets less current liabilities | | | | | | | | | | | | | |
| 1967-68 | 7.2 | - | 42.1 | - | 12.3 | 8.6 | 9.2 | 10.0 | 6.1 | 6.1 | 1.6 | 6.3 | 5.1 |
| 1968-69 | 6.4 | 51.4 | 39.5 | 11.0 | 6.6 | 8.7 | 6.2 | 5.8 | 5.9 | 6.3 | 1.3 | 6.8 | |
| 1969-70 | 5.0 | - | - | - | 4.8 | 7.8 | 5.2 | 6.2 | 5.2 | 5.0 | 6.8 | 3.1 | |
| Cash flow as percent of total assets less current liabilities | | | | | | | | | | | | | |
| 1967-68 | 12.0 | - | 41.3 | - | 19.9 | 17.7 | 15.9 | 15.3 | 11.7 | 10.6 | 5.5 | 10.8 | 10.9 |
| 1968-69 | 11.5 | 82.6 | 50.3 | 22.4 | 15.6 | 17.0 | 13.3 | 12.0 | 11.9 | 11.4 | 7.9 | 11.0 | |
| 1969-70 | 10.4 | - | - | - | 18.8 | 15.9 | 13.0 | 11.0 | 11.4 | 12.4 | 9.4 | 9.6 | |

Source: Almanac of Business and Industrial Financial Ratios, 1971, 1972, 1973. Ed., Prentice Hall; Inc. These data are from Internal Revenue Service Corporation Statistics and Income.

frozen orange juice concentrate with spinach varying widely from less than 0 to 36 percent.

Cash flow as a percent of total assets less current liabilities for the total industry are shown in Table III-12. A similar pattern exist for net income as a percent of total assets less current liabilities. The results range from a high of 12 percent for 1967-68 and decrease to 10.4 for 1969-70. The model plant data generally averages between 10 and 20 percent with the exception as noted earlier dropping to 0 or increasing to 3 percent.

Overall, the results of the comparison of model plant data with actual industry averages, recognizing different years are involved, indicates that the model plants are operating at a slightly higher rate of profit on sales as well as higher returns on total assets less current liabilities than actual industry performance during the 1967-70 period. The model plant data for the 71-72 year would be more indicative of the 1965-67 period when profits in the industry were higher. It is evident from the industry data that wide variation exists in the industry -- especially when such a broad spectrum of plant sizes, products and types of processing are averaged into one category.

It would appear, at this stage, that the model plants reflect conditions of individual industry segments in a representative manner. This is especially true since it is generally recognized that the industry experienced higher profits in the 71-72 season than during the 1968-70 season.

## D. Ability to Finance New Investment

The ability of a firm to finance new investment for pollution abatement is a function of several critical financial and economic factors. In general terms, new capital must come from one or more of the following sources: (1) funds borrowed from outside sources; (2) new equity capital through the sale of new common or preferred stock; (3) internally generated funds -- retained earnings and the stream of funds attributed to depreciation of fixed assets.

For each of the three major sources of new investment, the most critical set of factors is the financial condition of the individual firm. For debt financing, the firm's credit rating, earnings record over a period of years, existing debt-equity ratio and the lenders' confidence in management will be major considerations. New equity funds through the sale of securities will depend upon the firm's future earnings as anticipated by investors, which in turn will reflect past earnings records. The firm's record, compared to others in its own industry and to firms in other similar industries, will be a major determinant of the ease with which new equity capital can be acquired. In the comparisons, the investor will probably look at the trend of earnings for the past five or so years.

Internally generated funds depend upon the margin of profitability and the cash flow from operations. Also, in publicly held corporations, stockholders must be willing to forego dividends in order to make earnings available for reinvestment.

The condition of the firm's industry and general economic conditions are also major factors in attracting new capital. The industry will be compared to other similar industries (other manufacturing industries) in terms of net profits on sales and on net worth, supply-demand, relationships, trends in production and consumption, the state of technology, impact of government regulation, foreign trade and other significant variables. Declining or depressed industries are not good prospects for attracting new capital. At the same time, the overall condition of the domestic and international economy can influence capital markets.

The food canning and freezing industries in the United States are highly competitive with a large number of relatively small firms. Profit margins on sales are low and highly volatile both for individual plants and for the industry as a whole. Detailed information on the profit position of respective type and size companies is simply not available and only broad industry averages can be obtained.

According to the Census of Manufacturers the total number of canning plants decreased from 1,607 in 1958 to 1,223 in 1967 a reduction of 24 percent in the 10 year period. While it cannot be quantitatively stated, it is believed that the firm shut downs are basically the older, small plants. This trend has been continuing for the past thirty years and no doubt will continue for some time as the smallest third of the plants account for only 5-10 of the total pack and are generally considered to be old and small.

A compositive income statement for canned fruits and vegetable (SIC2033) was obtained from the National Canners Association and is presented in Table III-15. (Profits before tax, all canners and freezers as taken from IRS data in the Almanac of Business and Industrial Financial Ratios is included as a comparison.) No similar statement has been obtained for the freezer industry. Total sales in the canned fruits and vegetable industry amount to $3.7 billion. Labor costs amount to $613 million or 16.6 percent of sales. This has increased from 15.4 percent of sales in 1965. Fresh fruit and vegetable costs declined sharply in 1969 and 1970 to 21.4 percent. Profits were also lower during the past three years and averaged 2.3 percent of sales compared with an average of 4.0 percent during the 1965 through 1967 period. According to earlier survey of income and earnings over a five year period by the National Canners Association, an average of 54 firms operated on a profitable basis each year and an average of 10 firms operated on a loss basis of about 16 percent. (According to the IRS data, 48 percent of the canners reported a negative income in the 1969-70 year, 29 percent in 1968-69 and 38 percent in 1967-68).

When net income as a percent of equity in the fruit and vegetable canning industry is compared with other types of companies, they compared favorably. For the 65-67 period (Table III-16) net income as a percent of equity amounted to 9.9 percent compared with 9.2 for all canned and frozen foods, 10.1 for total manufacturing and 8.1 for all corporations. During the 1968-70 period, however, net income dropped sharply to 4.6 percent. Information for other industry groups was not available for comparative purposes. No information is available as to net income by type of size of firm.

The number of freezing firms increased from 426 in 1958 to 608 in 1967 according to the Census of Manufacturers. Generally freezing plants have been constructed more recently than canning plantsand are larger in size. A recent article by Quick Frozen Foods[1] reporting the findings of their annual survey of frozen food packers (contains also seafoods, meats, prepared foods, etc.) reported that 62 percent of the frozen food packers queried intend to build new FF processing plants or renovate old ones. Approximately one-fourth of those contacted in the survey indicated expansion programs of more than $1,000,000.

With the increase in volume in the freezing industry, increase in plant number and current plans for expansion it would appear that the freezers are in a relatively better situation than canners to meet the added cost of pollution control equipment.

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[1] Katz, Arnie, "Annual Survey of Construction and Equipment Purchasing Plan", Quick Frozen Foods, Cahner Publishing Company, Inc., New York, N.Y., March, 1973.

Table III-15. Income Statement, Canned Fruits and Vegetables (SIC 2033)

| | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 |
|---|---|---|---|---|---|---|
| | | | Millions of Dollars | | | |
| Sales | 2,982.0 | 3,215.8 | 3,467.8 | 3,654.1 | 3,670.1 | 3,700.0 |
| Labor cost | 457.9 | 492.5 | 536.4 | 582.9 | 594.6 | 613.4 |
| Wages | 317.8 | 341.1 | 376.0 | 409.5 | 419.5 | 424.5 |
| Salaries | 89.3 | 92.8 | 97.8 | 106.5 | 104.9 | 114.6 |
| Supplementary labor costs | 50.8 | 58.5 | 62.6 | 66.9 | 70.2 | 74.3 |
| Materials & other costs | 2,343.7 | 2,527.4 | 2,725.7 | 2,881.9 | 2,943.4 | 2,916.4 |
| Fresh fruits & vegetables | 702.9 | 769.5 | 812.7 | 876.6 | 810.7 | 793.2 |
| Other food ingredients | | | 170.5 | | | |
| Containers | 571.4 | 614.5 | 627.5 | 708.5 | 720.8 | 728.2 |
| Other materials, supplies, etc. | | | 443.8 | | | |
| All other costs | | | 671.2 | | | |
| Depreciation | 63.7 | 62.0 | 72.0 | 77.1 | 80.7 | 81.4 |
| Profits before tax | 116.7 | 133.9 | 133.7 | 112.2 | 51.4 | 88.8 |
| | | | Percent of Sales | | | |
| Total labor cost | 15.4 | 15.3 | 15.5 | 16.0 | 16.2 | 16.6 |
| Wages | 10.7 | 10.6 | 10.8 | 11.2 | 11.4 | 11.5 |
| Fresh fruit & vegetable costs | 23.6 | 23.9 | 23.4 | 24.0 | 22.1 | 21.4 |
| Other food ingredient costs | | | 4.9 | | | |
| Container costs | 19.2 | 19.1 | 18.1 | 19.4 | 19.6 | 19.7 |
| Profits before tax | 3.9 | 4.2 | 3.9 | 3.1 | 1.4 | 2.4 |
| Profit before tax, all canners & freezers | - | - | - | 3.6 | 2.3 | 1.8 |

Source: National Canners Association, developed by Townsend-Greenspan and Company, Economic Consultants, One New York Plaza, New York, N.Y., Oct. 1971.

Sales - 1958-1969 from Census of Manufacturers. 1970 estimated on basis of detailed price and volume data on packs of individual fruits and vegetables.

<u>Almanac of Business and Industrial Financial Ratios, 1973,</u> ed. Prentice-Hall

continued--

Table 15 (continued)

Labor Cost - Payroll, 1958-1969 from Census of Manufactures. 1970 estimate from Bureau of Labor Statistics data. Fringe benefits, levels for 1957, 1967 and 1968, from 1958 Census of Manufactures and Annual Survey of Manufactures 1968. Other years estimated from data for SIC 20 in National Income Accounts.

Cost of Materials - Costs of fruits, vegetables and containers, Census of Manufactures for 1958, 1963 and 1967. Other years interpolated on basis of data in Tables 2 - 6. Other food ingredients, Census of Manufactures. Other materials, supplies, Census of Manufactures.

Depreciation - Based on data for SIC 203 from Internal Revenue Service, Corporation Source Books of Statistics of Income.

Profits - Profit margins derived from Touche Ross data for (1) a sample of California canners 1960-1968, and Northwest, East and Midwest canners for 1960-1964, and (2) a smaller sample of total company pretax margins for 1960-1970. Regional data were reweighted according to national totals from the Census of Manufactures and margin trends calculated using Census profit margin proxies (ratio of value added less payroll to total sales). Estimates for 1958 and 1959 were obtained by linking to data for SIC 203 from IRS Source Books.

All Other Costs - Derived as residual.

Table III-16. Net Income as a Per Cent of Equity

| | (1) All Corporations | (2) Total Manufacturing | (3) Food & Kindred Products | (4) Canned & Frozen Foods | (5) Canning Industry Selected Group (1) |
|---|---|---|---|---|---|
| Annual averages: | | | | | |
| 1959-61 | 5.9 | 6.8 | 7.3 | 8.0 | n.a |
| 1962-64 | 6.4 | 7.9 | 7.9 | 6.4 | 8.1a |
| 1965-67 | 8.1 | 10.1 | 9.2 | 9.2 | 9.9 |
| 1968-70 | n.a. | n.a. | n.a. | 7.8 | 4.6 |

(1) Total company, including other seasonal and nonseasonal food products and certain foreign and other operations.

a - Average of 1963 and 1964

n.a. - Not available.

Source: National Canners Association as developed by Townsend-Greenspan and Company.
Cols. 1 through 4 - Internal Revenue Service, "Corporation Income Tax Returns."
Col. 5 - Touche Ross & Co. study of nine major fruit and vegetable canners.

In general, it is not anticipated that there will be any serious constraints in securing capital required for pollution control for large and medium size canners and especially freezers. However, in individual situations where plants are old, obsolete or unprofitable, and where local conditions may require substantial investments for internal pollution abatement systems or for participation in expanding capacity of sewer systems in small communities, fruit and vegetable management may hesitate to make the investments required -- even though capital may be available.

Capital availability may be a much more serious problem for small plants which continue to operate primarily because owners have depreciated out original investment costs, consider their investment in the plant as "sunk capital" and consider that the plant has a "utility value" if continued in operation which is greater than the "market value" or "salvage value" of the plant should they decide to cease operations. For such plants, the increased investment required for pollution control may be difficult to obtain and even if available may be unattractive to both the borrower and the lender. In these situations, the decision to attempt to obtain additional capital may be based on the desire of the owners to maintain the business for personal employment reasons rather than on the expectation of realizing a return on invested capital.

# IV. PRICING EFFECTS

Environmental quality enhancement or the prevention of further environmental quality degradation is not a free good and as such must be borne by either producers, consumers or intermediaries.

This chapter briefly explores the possible price effect of mandatory pollution abatement standards on the fruit and vegetable canning, freezing and dehydrating industries.

Such a discussion is broad in scope and inevitably leads to the discussion of many diverse topics. The emphasis here will be confined to a brief discussion of price determination within the industry and the possible price effects emanating from the inauguration of mandatory pollution abatement standards.

## A. Price Determination

Although the fruit and vegetable processing industry is characterized by the existence of large multi-product, multi-plant firms, where a relatively small number of firms process a high proportion of the total output, the industry is nevertheless highly competitive. There are a large number of small canners and freezers and the industry is faced with the necessity of selling a high proportion of its total pack to large national food chains. Plants and firms located in any region are potential competitors to those producing the same product lines in all other regions.

The resultant effect of the above structure dictates that prices are determined largely on a competitive basis under conditions of supply and demand. This chapter explores briefly these conditions.

## 1. Demand

The primary demand for processed fruits and vegetables--canned, frozen, dried or dehydrated--is a nation-wide market of consumers served mainly through retail food stores. Secondary, but nevertheless important, markets are found among institutional food purveyors (hotels, restaurants, in-plant feeding, schools, etc.), governmental purchases for military, school lunch and needy persons subsistence programs and purchases by further processors who use processed fruits and vegetables in the manufacture of prepared dinners and other convenience foods. For some products, mainly fruits, there exists an important export market.

Long-run changes in demand for processed fruits and vegetables are affected by gradual changes in dietary patterns and preferences of consumers and by technological processes which improve the availability and convenience of these foods for the consumer.

Short-run changes in demand are influenced by seasonal and year-to-year variations in production of fruits and vegetables for processing and for fresh use. Carry-over stocks of canned and frozen products are important in relation to short-run demands, but in the long-run the entire pack of both canned and frozen products ultimately moves into consumption.

### a. Aggregate Demand for Processed Fruits and Vegetables

Aggregate demand for processed fruits and vegetables can best be examined by exploring trends in per capita consumption of major product groupings, briefly looking at government purchases and international markets, then examining total pack by major product lines (to expedite discussion, an examination of carry-over stocks will not be made in this discussion, it is assumed that total pack represents consumption).

### i. Per Capita Consumption of Fruits and Vegetables

Some very distinct changes have occurred in the patterns of consumption of fruit and vegetables by the American consumer over the past two decades. These patterns can best be examined by viewing past utilization trends. Changes in consumption patterns generally reflect the interaction of various factors such as production, price, rising income, population, new food styles, and more casual and informal living.

Fruits - After a record high per capita consumption of all fruits in 1946 of 225 pounds (fresh equivalent) -- partially the result of restocking pantry shelves and retail stores following the wartime scarcity -- consumption leveled off to approximately 200 pounds in the early 50's. During the last two decades annual per capita consumption of all fruits combined fluctuated from a high of 203 pounds in 1952 to a low of 165 pounds in 1964. Present level is at about 200 pounds on a fresh equivalent basis.

Total consumption of processed fruits (product weight basis) have increased steadily from 43 pounds per capita in 1950 to 55 pounds by 1971. According to USDA specialists, consumption will climb to about 60-61 pounds by 1980 (Table IV-1).

Canned fruits have averaged a consistent 23-24 pounds per capita during the past 10 years and are expected to hold at the present level through 1980.

Canned juices, however, have increased from 15 pounds per capita in 1960 to 20 pounds by 1971. According to USDA specialists, per capita consumption of canned juices can be expected to climb to about 23 pounds per capita by 1980.

Dried fruits have steadily declined in importance from 1950 dropping from 4.1 pounds per capita on a processed dried weight basis to 2.6 pounds in 1971. This includes dried apples, apricots, dates, figs, peaches, pears, prunes and raisins.

Frozen fruits (including frozen citrus juices) have also increased steadily from 4.3 pounds in 1950 to approximately 10 pounds per capita during the past five years. This can be expected to increase slightly to approximately 12 pounds per capita by 1980.

Vegetables - The consumption of vegetables (fresh equivalent)[1/] has increased gradually over the past 20 years from about 200 pounds per capita to the present rate of consumption of about 210 pounds (Table IV-2). Future consumption is not projected to change drastically with total per capita consumption in 1980 projected to be about 215-220 pounds.

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[1/] The canned and frozen consumption estimates are based on the commonly used "fresh equivalent basis." This means that the 94 pounds of canned (fresh equivalent) reported for 1969 would actually amount to 51 pounds of consumption (about 54 percent). For frozen vegetables it would amount to about 9 pounds of actual consumption for 20 pounds of fresh equivalent (44 percent).

Table IV -1. Processed fruits: per capita civilian consumption, United States, 1929-71

| Year | Canned fruits[1] | Canned juices[2] | Dried fruits[3] | Frozen fruits[4] | Total |
|---|---|---|---|---|---|
| | (lbs.) | (lbs.) | (lbs.) | (lbs.) | (lbs.) |
| 1950 | 21.6 | 13.5 | 4.1 | 4.3 | 43.5 |
| 1951 | 19.0 | 15.0 | 3.8 | 4.8 | 42.6 |
| 1952 | 20.8 | 14.1 | 3.8 | 6.6 | 45.3 |
| 1953 | 21.0 | 13.4 | 3.8 | 7.1 | 45.3 |
| 1954 | 21.2 | 13.2 | 3.9 | 7.4 | 45.7 |
| 1955 | 22.5 | 12.0 | 3.6 | 8.7 | 49.8 |
| 1956 | 21.9 | 14.8 | 3.7 | 8.8 | 49.2 |
| 1957 | 22.6 | 15.6 | 3.6 | 9.0 | 50.8 |
| 1958 | 22.9 | 16.1 | 3.0 | 7.9 | 49.9 |
| 1959 | 22.3 | 14.0 | 3.2 | 8.8 | 48.3 |
| 1960 | 23.0 | 15.1 | 3.1 | 9.1 | 50.3 |
| 1961 | 23.6 | 13.4 | 3.1 | 8.8 | 48.9 |
| 1962 | 23.2 | 14.0 | 3.0 | 9.7 | 49.9 |
| 1963 | 23.3 | 14.2 | 2.9 | 8.0 | 48.4 |
| 1964 | 23.4 | 12.9 | 2.9 | 7.4 | 46.6 |
| 1965 | 23.8 | 12.9 | 3.0 | 8.5 | 48.2 |
| 1966 | 23.4 | 14.9 | 3.0 | 8.1 | 49.4 |
| 1967 | 23.1 | 16.1 | 2.8 | 10.1 | 52.1 |
| 1968 | 22.3 | 16.4 | 2.8 | 9.4 | 50.9 |
| 1969 | 24.6 | 18.9 | 2.7 | 9.3 | 55.5 |
| 1970 | 23.7 | 18.9 | 2.7 | 9.8 | 55.1 |
| 1971 | 22.2 | 20.2 | 2.6 | 10.2 | 55.2 |

[1] Apples, applesauce, apricots, berries, cherries (including brined), cranberries, figs, fruit cocktail and salad, citrus sections, olives (including brined), pineapple, plums, prunes, peaches (including spiced), and pears.

[2] Grapefruit, orange, blended citrus, lemon and lime, tangerine and blends, pineapple, apple, grape, and prune juices, and fruit nectars. Including canned concentrated citrus juices converted to single-strength basis but excludes all frozen juices.

[3] Dried apples, apricots, dates, figs, peaches, pears, prunes, and raisins. Excludes unmerchantable figs, substandard prunes, and prunes used for juice and concentrate. Data are in terms of processed dried weight.

[4] Principally cherries, apples, peaches, apricots, strawberries, other berries, and citrus juices.

Table IV-2. Commercially produced vegetables: Civilian per capita consumption, United States, 1950-71

| Year | Total fresh and processed | Fresh[1] | Processed | | |
|---|---|---|---|---|---|
| | | | Total | Canned | Frozen |
| | (lbs.) | (lbs.) | (lbs.) | (lbs.) | (lbs.) |
| 1950 | 199.2 | 115.2 | 84.0 | 76.6 | 7.4 |
| 1951 | 200.8 | 111.9 | 88.9 | 79.6 | 9.3 |
| 1952 | 199.7 | 111.6 | 88.1 | 76.8 | 11.3 |
| 1953 | 200.2 | 109.1 | 91.1 | 79.4 | 11.7 |
| 1954 | 196.2 | 107.2 | 89.0 | 76.8 | 12.2 |
| 1955 | 198.5 | 105.2 | 93.3 | 80.2 | 13.1 |
| 1956 | 201.5 | 107.0 | 94.5 | 80.9 | 13.6 |
| 1957 | 201.0 | 106.4 | 94.6 | 80.6 | 14.0 |
| 1958 | 199.9 | 103.7 | 96.2 | 81.5 | 14.7 |
| 1959 | 198.4 | 102.3 | 96.1 | 81.2 | 14.9 |
| 1960 | 202.5 | 105.9 | 96.6 | 81.7 | 14.9 |
| 1961 | 199.9 | 103.8 | 96.1 | 81.3 | 14.8 |
| 1962 | 201.12 | 101.4 | 99.7 | 83.7 | 16.0 |
| 1963 | 201.7 | 101.4 | 100.3 | 84.9 | 15.4 |
| 1964 | 198.5 | 98.6 | 99.9 | 83.7 | 16.2 |
| 1965 | 201.3 | 98.6 | 102.7 | 85.3 | 17.4 |
| 1966 | 201.7 | 96.0 | 105.7 | 86.8 | 18.9 |
| 1967 | 209.2 | 98.1 | 111.1 | 91.2 | 19.9 |
| 1968 | 212.3 | 98.7 | 113.6 | 92.6 | 21.0 |
| 1969 | 213.0 | 98.9 | 114.1 | 94.6 | 19.5 |
| 1970 | 213.7 | 98.9 | 114.8 | 93.9 | 20.9 |
| 1971[2] | 210.7 | 97.3 | 113.4 | 94.0 | 19.4 |

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[1] Excludes melons. Data include pickles and sauerkraut in bulk; excludes canned and frozen potatoes, canned sweetpotatoes, canned baby foods, and canned soups.

[2] Preliminary.

During these same years a gradual increase in the consumption of canned and frozen vegetables has occurred. Since total consumption did not appreciably change, this increase has been at the expense of the fresh product share of the market. The convenience of using processed products, plus their ability to compete on terms of quality and price has stimulated increases in the consumption of both frozen and canned vegetables.

Canned vegetable consumption climbed from 77 pounds per capita in 1950 to 94 pounds in 1969 where it has held through 1971. At the same time, frozen consumption has climbed steadily from the early 1950's to nearly 20 pounds in 1971. Fresh consumption, however, decreased from about 115 pounds in 1950 to 105 pounds in 1960. Further decline has placed per capita fresh consumption at about 98 pounds for the past five years.

USDA specialists believe that the major shift from fresh to canned and frozen has leveled out. Although total canned and frozen consumption is expected to increase from the current 114 pounds per capita to about 120 by 1980. This will not be at the expense of fresh produce, but will represent an increase in total consumption. Most of this gain will be taken up by frozen commodities which should increase to about 24 pounds by 1980. Fresh vegetables are projected to remain at the same level for the remainder of the decade.

Potatoes - The above data exclude the consumption of processed potatoes. Demand for potatoes and potato products has changed markedly during the past decade. Annual per capita consumption (fresh and processed combined on a fresh weight equivalent basis) rose from 108.4 pounds in 1960 to 118.4 pounds in 1970. The increase is credited entirely to processed use, which rose from 24 pounds in 1960 to 59 pounds in 1970. In contrast, fresh per capita potato consumption fell from 85 to 60 pounds.

Among the processed potato products, use of frozen french fries has risen the most. In 1960, people ate less than 7 pounds (fresh weight equivalent) of potatoes in the frozen form. Ten years later they ate 28 pounds, or nearly half of all potatoes processed compared with only 28 percent in 1960. Further gains in the use of frozen french fires have occurred since 1970. A preliminary estimate of per capita consumption showed 32.5 pounds per person in 1972.

Chips increased from 11.6 to 17.7 pounds but took approximately 50 percent of all processed potatoes in the early 1960's, declining to 30 percent in 1970. Per capita use of dehydrated potatoes moved upward enough to have a significant impact on total processed usage. Dehydrated potatoes accounted for about a fifth of all potatoes used for processing in most years. Per capita consumption rose from 5 pounds to 13 pounds. Per capita use of canned potatoes was small, less than 1 pound throughout the period.

Several factors are behind these changes in per capita consumption. Retail price trends have encouraged the shift to processed potatoes, especially the frozen. Prices of fresh potatoes increased from 71.8 cents for 10 pounds in 1960 to 89.7 cents in 1970. Retail prices of frozen french fries declined from 19.7 cents for 9 ounces in 1960 to 16.6 cents in 1970.

Other factors include changes in consumer tastes and preferences and living patterns which include more working wives and desire for more convenience. Processed potatoes are essentially convenient and time-saving foods. Also, frozen and dehydrated potato products are popular with the institutional trade, i.e., the away-from-home trade where convenience, uniformity, quality and portion control are important.

### ii. International Trade

Exports - Although there is an appreciable year-to-year variation in the export of individual fruit and vegetable items, little trend is apparent over the last five years in U. S. exports of canned and frozen fruit, vegetable and juice products. The following data indicate the export volumes for general product categories, 1967-1970.

| | | Export Volume | | | | |
|---|---|---|---|---|---|---|
| Products | Unit | 1967 | 1968 | 1969 | 1970 | 1971 |
| Canned fruits | (000 lbs) | 354,809 | 302,234 | 439,990 | 396,261 | 321,850 |
| Canned vegetables | (000 lbs) | 100,261 | 89,764 | 107,384 | 102,587 | 84,717 |
| Canned juice | (000 gal) | 33,115 | 29,992 | 28,199 | 32,135 | 28,516 |
| Frozen juices | (000 gal) | 5,419 | 5,162 | 5,437 | 7,815 | 9,641 |
| Frozen fruits & veg. | (000 lbs) | 32,377 | 32,276 | 34,351 | 30,342 | 24,036 |

These data do show the dominance of canned fruits in the export trade. While the pack of canned vegetables in the United States is approximately twice that of canned fruits, exports of canned fruits equal approximately three times the volume of canned vegetables.

Exports of canned vegetables, fruits and juices are shown in Table IV-3 for 1970 and 1971. As can be seen. exports of canned vegetables are not significant, in terms of total pack, for any item. Canada is the major export market for most products, although Japan is first for sweet corn and Hong Kong is an important market for both corn and tomato catsup.

The situation is different for canned fruits. Export markets are relatively important, taking 14.7 percent of the fruit cocktail pack, 14.5 percent of the cherry pack, 12.6 percent of the peach pack and 9.1 percent of the pineapple pack for 1970. West Germany and other Western Euorpean countries plus Canada are the major export markets for canned fruit products.

Much the same situation exists for canned fruit juices. Export markets take 41.5 percent of the hot-pack orange juice. The U. S. market has turned largely toward frozen concentrated orange juice, but there is still a good market for hot-pack juice in Canada, Western Europe and Sweden. A good export market (18.5 percent of total pack) also exists for canned grapefruit juice and 9.8 percent of the pack of canned pineapple juice is exported. In contrast, only 2.8 percent of the pack of canned tomato juice is exported.

Frozen concentrated orange juice is the principal frozen product exported. Over six million gallons (60 million pounds) were exported in 1970, and nearly eight million gallons in 1971, a volume greater than all other frozen fruit, vegetable and juice products. Canada, Sweden, United Kingdom, and West Germany were the principal export markets served. However, in terms of total U. S. pack, exports of frozen, concentrated orange juice accounted for only 5.6 percent of total pack.

The export market for frozen concentrated grapefruit juice, while smaller than for orange juice (998,000 gallons) accounted for 16 percent of total pack in 1971.

Exports of frozen vegetables in 1970 were 25,798,000 pounds, but accounted for only 0.6 percent of total pack.

Table IV-3. Exports of major canned and frozen vegetables, fruits and juices, 1970 and 1971

| Product | 1970 | 1971 | % of Pack | Major Countries |
|---|---|---|---|---|
| | (000 lbs) | | (1970) | |
| Canned vegetables | | | | |
| Tomatoes | 19,146 | 17,381 | 2.4 | Canada |
| Corn | 15,574 | 14,740 | 1.3 | Japan<br>Hong Kong<br>Denmark<br>Sweden<br>W. Germany<br>France<br>Nigeria<br>Switzerland |
| Tomato puree and conc. | 9,994 | 6,301 | 4.1 | United Kingdom<br>Canada |
| Beans, nec | 7,638 | 3,123 | 0.7 | Dominican Republic<br>Panama<br>Canada |
| Asparagus | 7,486 | 4,484 | 4.4 | Denmark<br>Sweden<br>Belgium-Lux.<br>W. Germany<br>United Kingdom |
| Tom. catsup and Chili sauce | 6,967 | 10,576 | 0.7 | Hong Kong<br>Canada |
| Other | 35,782 | 27,612 | - | |
| Total Canned Veget Vegetables | 102,587 | 84,717 | - | |
| Frozen vegetables (all) | 25,798 | 17,905 | 0.6 | Canada<br>United Kingdom<br>Denmark<br>Sweden<br>Bermuda<br>Australia<br>W. Germany |

Table IV -3. Exports of major canned and frozen vegetables, fruits and juices, 1970 and 1971 (continued)

| Product | 1970 | 1971 | % of Pack | Major Countries |
|---|---|---|---|---|
| | (000 lbs) | | (1970) | |
| Canned fruits | | | | |
| Peaches | 165,573 | 137,811 | 12.6 | W. Germany<br>Canada<br>Switzerland<br>Belgium-Lux.<br>Sweden<br>Netherlands<br>Austria |
| Fruit cocktail | 108,773 | 76,832 | 14.7 | Canada<br>W. Germany<br>Belgium-Lux. |
| Pineapple | 68,648 | 63,321 | | W. Germany<br>Belgium-Lux.<br>France<br>Canada<br>Netherlands<br>Switzerland |
| Cherries | 3,301 | 3,192 | 3.1 | W. Germany<br>Belgium-Lux.<br>Netherlands<br>Rep. South Africa |
| Pears | 8,743 | 10,109 | 2.1 | W. Germany<br>Canada |
| Other | 41,223 | 30,585 | - | |
| Total Canned Fruits | 396,261 | 321,850 | - | |
| Canned juices | | | | |
| Pineapple | 3,749 | 3,051 | 9.8 | Canada |
| Grapefruit, single strength | 5,990 | 4,940 | 18.5 | Canada |
| Orange, single str. and conc. | 12,632 | 10,363 | 41.5 | Canada<br>Sweden<br>France<br>W. Germany |

Table IV-3. Exports of major canned and frozen vegetables, fruits and juices, 1970 and 1971 (continued)

| Product | 1970 | 1971 | % of Pack | Major Countries |
|---|---|---|---|---|
| | (000 lbs) | | (1970) | |
| Canned juices (continued) | | | | |
| Tomato | 1,589 | 1,461 | 2.8 | Japan<br>Saudi Arabia<br>Canada |
| Other | 8,175 | 8,701 | - | |
| Total canned juices | 32,135 | 28,516 | - | |
| Frozen juices | | | | |
| Orange, froz. conc. | 6,097 | 7,839 | 5.6 | Canada<br>Sweden<br>United Kingdom<br>W. Germany |
| Grapefruit, froz. conc. | 939 | 998 | 15.9 | Canada<br>Australia<br>W. Germany |

While exports of canned and frozen fruit, vegetable and juice products were valued at over $143, 000, 000 in 1970, they still represent but a small percentage of the total pack of these products. There are individual exceptions such as canned, hot pack orange and grapefruit juice, canned cherries, fruit cocktail and peaches where important export markets exist. However, for most fruits, vegetables and juices, either canned or frozen, the private, domestic market is still the dominant outlet.

Imports - The greatest competition with regard to imports of fruits and vegetables is from the importation of fresh products. Imports of processed fruits, vegetables and juices are primarily tropical or subtropical products not produced in the United States. However, for certain products, imports do constitute a major part of the total supply in the United States and do, therefore, compete directly with similar products processed by U. S. canners and freezers.

Imports of these products -- volume, relation to U. S. pack and principal countries of origin -- are shown in Table IV-4.

Imports of apple and pear juice, mainly from Switzerland and France, in 1970 totaled 16.8 million gallons -- equal to 45 percent of the U. S. pack. This doubled in 1971 to 34.0 million gallons.

Pineapple juice imports in 1970, 13.6 million gallons, were equal to 38 percent of the U. S. pack. Most of this import volume came from the Philippines. Canned pineapples imported from the Philippines, Taiwan, Mexico, Malaysia and Thailand equaled 32 percent of the U. S. pack.

Orange juice concentrate increased sharply from 1.5 million gallons in 1970 to 19.3 million gallons in 1971 or 15% of the U. S. pack.

Canada was a major supplier of frozen blueberries, equal to 25 percent of the U. S. pack, and Mexico exported nearly 84 million pounds of frozen strawberries to the United States, an amount equal to 46 percent of the U. S. pack in 1971.

Large quantities of canned mushrooms, nearly 31 million pounds, are received from Taiwan -- equal to 60 percent of the U. S. pack.

Nearly 200 million pounds of tomatoes, paste and sauce, came into the United States in 1970, mainly from Italy, Portugal and Spain.

Table IV-4. United States' imports of canned and frozen fruit and vegetable products, 1970 and 1971

| Product | Unit | 1970 | 1971 | % of U. S. Pack (1970) | Principal Countries of Origin |
|---|---|---|---|---|---|
| **Canned Fruit Juices** | | | | | |
| Apple and pear juice | 000 gal. | 16,900 | 34,024 | 45 | Switzerland<br>France<br>Austria |
| Orange juice, conc. | 000 gal. | 1,461 | 19,343 | 15 | Brazil |
| Pineapple juice | 000 gal. | 13,595 | 13,143 | 35 | Philippines |
| **Canned & Froz. Fruits** | | | | | |
| Blueberries, frozen | 000 lbs. | 11,099 | 8,433 | 29 | Canada |
| Pineapples, canned | 000 lbs. | 239,773 | 259,685 | 32 | Philippines<br>Taiwan<br>Mexico<br>Malaysia<br>Thailand |
| Strawberries, frozen | 000 lbs. | 109,738 | 84,565 | 61 | Mexico |
| **Canned Vegetables** | | | | | |
| Tomatoes, paste & sauce | 000 lbs. | 91,382 | 97,817 | 8 | Portugal |
| Tomatoes, except paste | 000 lbs. | 128,534 | 108,557 | 16 | Italy<br>Spain |
| Mushrooms, prep. pres. except dried | 000 lbs. | 24.808 | 30,763 | 70 | Taiwan |

Although imports of canned and frozen fruits, vegetables and juices are relatively minor when compared to the total U. S. pack of these products, imports are important in competition with certain products. Most important are:

1. Frozen strawberries
2. Canned mushrooms
3. Canned apple and pear juice
4. Canned pineapple juice
5. Canned pineapple
6. Frozen blueberries.

### iii. Government Purchases

Government purchases of canned and frozen fruits, vegetables and juices are made primarily to supply the requirements of the Armed Services, Veterans Administration, School Lunch Program and Needy Families Programs.

Canned Products - Although the volume of purchases varies substantially from year to year for specific canned fruit or vegetable items, there has been no consistent trend in the volume of government purchases (either up or down) for individual items or aggregate volume during the period 1966-1971. Total government purchases of canned products during the past five years were as follows:

| Year | All Vegetables | All Fruits | All Juices |
|---|---|---|---|
| | 000/Cases<br>24/303 | 000/Cases<br>23/2 1/2 | 000/Cases<br>24/2 |
| 1966 | 16,437 | 6,337 | 4,409 |
| 1967 | 16,355 | 9,621 | 9,101 |
| 1968 | 12,475 | 5,300 | 3,272 |
| 1969 | 18,302 | 5,574 | 8,218 |
| 1970 | 13,167 | 7,142 | 8,050 |
| 1971 | 11,126 | 6,590 | 7,892 |

The principal canned vegetables purchased in volume were tomatoes and tomato paste, green beans and sweet corn. In relation to total pack, government purchases of canned vegetables varied between a low of 1.6 percent for sauerkraut and a high of 8.2 percent for tomatoes and tomato paste.

Only two canned fruits were purchased in large volumes -- peaches and applesauce. In relation to total pack, government purchases varied from a low of 1.9 percent for fruit cocktail to 7.8 percent of the total apricot pack.

Government purchases of canned juices were relatively more important in relation to total volume packed, accounting for 12.8 percent of the pack of apple juice, 11.8 percent of the pineapple juice and 11.4 percent of the canned orange juice pack.

In summary, government purchases of canned fruit and vegetable products are an important element of total market demand, but do not occupy a dominant position.

Frozen Products - There was an increasing trend in military purchases of frozen vegetables, volume increasing from 67,981,000 lbs. in 1966-to 83,865,000 in 1970, but declined to 73,260,000 in 1971. Increases were the result of substantial increases in purchase of frozen potato items. However, the trend appears to be decreasing for other frozen vegetables and frozen fruits or juices. Total government purchases of frozen vegetable, fruit and juice products during the past six years were as follows.

| Year | Frozen Vegetables (000 lbs.) | Frozen Fruits (000 lbs.) | Frozen Juices (000 lbs.) |
|---|---|---|---|
| 1966 | 67,981 | 24,895 | 24,460 |
| 1967 | 79,241 | 25,930 | 24,334 |
| 1968 | 72,592 | 23,883 | 18,750 |
| 1969 | 80,270 | 20,588 | 20,962 |
| 1970 | 83,865 | 19,227 | 18,321 |
| 1971 | 73,260 | 14,709 | 13,922 |

Potato products represent the greatest total volume, over 24 million pounds, of frozen vegetables but even so, government purchases represent only one percent of the total frozen pack of potato products. Other large volume items are mixed vegetables, green beans, peas, corn and broccoli. In terms of relative importance, government purchases were most significant for mixed vegetables (8.9% of pack), Brussels sprouts (7.2%), asparagus (6.8%) and cauliflower (6.7%) in 1970.

Principal frozen fruits purchased in 1971 were strawberries (5.4 million pounds) and peaches, 5.1 million pounds. Peaches were the only crop for which government purchases (12.5%) were a major part of the total sales.

Frozen concentrated orange juice goes mainly to the military subsistence and school lunch programs. Government purchases in 1971 were 8.9 million pounds, but this represented but 1.0% of the total pack of frozen concentrated orange juice.

In summary, as was true for government purchases of canned vegetables, fruits and juices, government purchases represent substantial product volumes for frozen products, but do not dominate in relation to total sales for specific products or volume in total.

### iv. Total Demand by Commodity

Although there is normally some carry-over from one packing season to the next, the total volume packed is the best indicator of aggregate demand by specific product.

Canned Vegetables - Table IV-5 shows the total packs for canned vegetable commodities for the 1969-70, 1970-71 and 1971-72 pack seasons. Total canned vegetable pack in the 1969-70 pack year was 326,474 thousand cases, 324,850 thousand cases in 1970-71 and 344,608 thousand cases for the 1971-72 season (estimated). While there has been a slight increase during the past few years the demand is relatively constant with slight increases due primarily to population increases.

Canned Fruits of Fruit Juices - Table IV-6 shows the total pack for canned fruits and fruit juices for 1969, 1970 and 1971 pack season. Total pack of canned fruits and fruit juices for 1969 was 232,084,000 actual cases and 205,130,000 actual cases in 1970. Estimated canned fruit and fruit juice packs in 1971-72 pack season are 205,972,000 actual cases. These packs compare with an average pack of 199,580,000 cases during the 1961-70 period.

Frozen Vegetables - Table IV-7 shows the total pack of frozen vegetables for 1969, 1970 and 1971. The pack for 1970 was 4,472.213,000 pounds, more than double the pack in 1961 (2.116,041,000 pounds) and nearly 50 percent above the 1961-70 average (3,123,665,000) pounds.) 1971 pack statistics snow an increase over the 1970 production levels with 4,697,787,000 estimated pounds.

In terms of total tonnage produced, potato products represent over half of the total volume, 2.4 billion pounds in 1970 compared to a total pack of 4.5 billion pounds. Other major vegetable items frozen included: peas

| | | |
|---|---|---|
| peas | 344 million lbs. | 7.7% of pack |
| corn, cut | 216 million lbs. | 4.8% of pack |
| beans | 212 million lbs. | 4.7% of pack |

Other important vegetables for freezing are broccoli, carrots and spinach.

Frozen Fruits and Fruit Juices - Frozen fruits and fruit juices do not show the consistent upward trend in volume that exists for frozen vegetables (Table IV-8).

Table IV-5. Summary of canned vegetable packs, 1969, 1970 and 1971[1]

| | Pack, 000 Cases 24/303 cans | | |
|---|---|---|---|
| Product | 1969-70 | 1970-71 | Estimated 1971-72 |
| Tomatoes & Tomato products - Total | 112,148 | 120,200 | 124,182 |
| Tomatoes, whole peeled | 32,036 | 39,017 | 38,385 |
| Tomato juice | 33,653 | 35,952 | 38,411 |
| Tomato catsup | 37,780[2] | 37,780[2] | 37,780[2] |
| Tomato chili sauce | 1,665 | 1,504 | 1,462 |
| Tomato puree | 7,014 | 5,947 | 7,844 |
| Corn, Sweet | 49,387 | 46,995 | 53,757 |
| Beans, Green | 42,481 | 43,189 | 45,213 |
| Peas, Green | 32,071 | 28,697 | 33,197 |
| Potatoes, Sweet | 12,499 | 9,846 | 9,846[3] |
| Beets | 11,339 | 11,310 | 11,310[3] |
| Sauerkraut | 10,569 | 12,088 | 12,088[3] |
| Asparagus | 6,817 | 5,972 | 5,542 |
| Spinach | 6,577 | 7,270 | 7,675 |
| Potatoes, White | 6,110 | 6,602 | 6,602[3] |
| Carrots | 5,463 | 5,388 | 5,388[3] |
| Pumpkin and Squash | 5,244 | 3,973 | 4,581 |
| Beans, Wax | 4,858 | 4,382 | 4,797 |
| Mixed Vegetables | 4,357 | 4,367 | 4,482 |
| Beans, Lima | 3,596 | 2,776 | 3,116 |
| Leafy greens | 3,440 | 3,527 | 4,443 |
| Peas, field | 2,946 | 2,393 | 2,742 |
| Carrot and Peas | 2,438 | 2,086 | 2,106 |
| Mushrooms | 2,032[4] | 2,032[4] | 2,032[4] |
| Pimentos | 876 | 627 | 738 |
| Okra and tomatoes | 475 | 348 | 378 |
| Succotash | 383 | 339 | 338 |
| Okra | 368 | 443 | 355 |
| Total | 326,474 | 324,850 | 344,608 |

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[1] Source: Division of Statistics, National Canners Association

[2] 1967 pack, data not available since that time

[3] 1970 pack, data not available for 1971-72.

[4] 1968 pack, data not available for 1969, 1970 or 1971-72.

## Table IV-6. Summary of canned fruit and fruit juice pack 1969, 1970 and 1971[1]

| Product | Pack, 000 Actual Cases | | |
|---|---|---|---|
| | 1969 | 1970 | 1971 |
| Peaches | 43, 645 | 33, 096 | 29, 885 |
| Apple Sauce | 27, 553 | 23, 647 | 23, 647[2] |
| Pineapple | 24, 256 | 25, 939 | 25, 939[2] |
| Fruit Cocktail | 23, 909 | 18, 319 | 19, 141 |
| Grapefruit Juice | 20, 080 | 23, 854 | 23, 854[2] |
| Orange Juice | 17, 082 | 17, 080 | 16, 966 |
| Pears | 13, 597 | 10, 906 | 13, 284 |
| Pineapple Juice | 13, 558 | 12, 387 | 12, 387[2] |
| Apple Juice | 13, 503 | 14, 472 | 14, 472[2] |
| Apricots | 7, 126 | 4, 654 | 4, 182 |
| Cranberry Sauce | 6, 692 | 7, 394 | 6, 551 |
| Grapefruit Segments | 3, 726 | 3, 629 | 3, 629[2] |
| Apples | 3, 128 | 2, 271 | 2, 271[2] |
| Other Fruits and Juices | 14, 229 | 10, 860 | 9, 764 |
| Total | 232, 084 | 205, 130 | 205, 972 |

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[1] Source: Division of Statistics, National Canners Association

[2] 1969-70 pack, 1971-72 data not yet available

Table IV-7. Summary of frozen vegetable packs, 1969, 1970 and 1971[1/]

| Product | Pack (000 lbs.) | | |
|---|---|---|---|
| | 1969 | 1970 | 1971 |
| Potato products | 2,048,408 | 2,404,389 | 2,565,118 |
| Peas | 367,323 | 344,520 | 348,418 |
| Corn, cut | 289,268 | 216,097 | 226,835 |
| Beans, green and wax | 197,799 | 212,362 | 228,763 |
| Broccoli | 153,784 | 185,157 | 189,600 |
| Carrots | 150,945 | 173,054 | 143,681 |
| Spinach | 107,182 | 145,694 | 156,991 |
| Mixed vegetables | 101,400 | 110,333 | 112,388 |
| Beans, lima, baby | 82,562 | 73,012 | 73,898 |
| Corn-on-cob | 73,914 | 80,889 | 106,893 |
| Cauliflower | 69,744 | 59,782 | 67,659 |
| Beans, lima, fordhook | 55,792 | 36,844 | 40,690 |
| Brussels sprouts | 40,083 | 42,663 | 49,195 |
| Other vegetables | 317,078 | 387,417 | 387,658 |
| Total | 4,055,282 | 4,472,213 | 4,697,787 |

[1/] Source: American Frozen Food Institute

Table IV-8. Summary of frozen fruit and fruit juice packs, 1969, 1970 and 1971[1]

| | Pack (000 lbs.) | | |
|---|---|---|---|
| Product | 1969 | 1970 | 1971 |
| Strawberries | 178, 693 | 201, 572 | 199, 399 |
| Cherries RSP | 140, 688 | 121, 271 | 159, 408 |
| Apples and sauce | 122, 293 | 100, 370 | 96, 999 |
| Orange Juice, conc. | 108, 043[2] | 126, 402[2] | 125, 187 |
| Peaches . | 53, 527 | 47, 471 | 59, 924 |
| Blueberries | 37, 663 | 21, 836 | 30, 441 |
| Raspberries, red | 27, 657 | 25, 409 | 24, 467 |
| Blackberries | 27, 184 | 29, 186 | 27, 536 |
| Other fruits, berries and juices | 90, 578 | 73, 573 | 67, 304 |
| Total | 678, 283 | 620, 688 | 665, 478 |

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[1] Source: American Frozen Food Institute

[2] Thousands of gallons, not included in pack totals,
equals 1, 069, 625, 000 lbs. 1969
1, 251, 379, 000 lbs. 1970

Four products dominate the pack of frozen fruits and juices. Frozen concentrated orange juice pack is more than equal to the entire pack of all other frozen fruits and juices and in 1970 amounted to 126, 402, 000 gallons or 1, 251, 379, 000 pounds as compared to a total pack of 620, 688, 000 pounds for all other frozen fruits. Among frozen fruits, strawberries--201.6 million pounds (32% of total frozen fruit pack) is by far the dominant product. Other important frozen fruits are cherries and apples and apple sauce.

### v. Expenditure Proportions

As of this point, the discussion of demand has been confined to physical measures such as total demand by product group, total demand by specific commodity or per capita consumption levels. One factor that has not been considered is retail expenditure proportions. The importance of canned and frozen fruits and vegetables as a portion of total expenditures or as a proportion of food expenditures is briefly discussed below. Table IV-9 presents expenditure proportions for canned and frozen fruits and vegetables relative to total retail expenditure and retail food expenditures.

Fruit and Vegetable Expenditures as a Proportion of Total Retail Expenditures - Expenditures for fresh, canned, frozen and dried fruits and vegetables comprise only 4.7 percent of total retail expenditures. If, however, fresh sales are deleted the proportion attributed to processed fruits and vegetables falls to less than 2 percent of retail sales. This includes canned, frozen and dehydrated fruit and vegetable products which contribute 1. 19, .34 and 0. 1 percent respectively.

Fruit and Vegetable Expenditures as a Proportion of Food Expenditures - The relative size or importance of canned, frozen, and dehydrated fruits and vegetables relative to total food expenditures is also presented in Table IV-9. Expenditures for fruit and vegetables (exclusive of potatoes) comprise 8. 1 and 8.3 percent of all retail food expenditures respectively.

More than half of this amount is for fresh products with the remainder divided among canners (3.2 percent), freezers (1.5) and dehydrators (.75 percent).

Table IV-9. Fruit and vegetable as a proportion of retail food and total expenditures

| | Proportions expressed as a percentage of | |
|---|---|---|
| Commodity | Food expenditure | All expenditure |
| Fruit | | |
| Fresh | 4.846 | 1.1045 |
| Canned | .217 | .5053 |
| Frozen | .746 | .1700 |
| Dried | .373 | .0850 |
| Total Fruit | 8.182 | 1.8648 |
| Vegetables | | |
| Fresh | 4.265 | .9721 |
| Canned | 3.002 | .6842 |
| Frozen | .746 | .1700 |
| Dried | .373 | .0850 |
| Total vegetables | 8.386 | 1.9113 |
| Potatoes | | |
| White | 1.226 | .2795 |
| Sweet | .174 | .0399 |
| Total Potatoes | 1.401 | .3194 |
| Total all food | 100.00 | 22.79 |
| Total nonfood | | 77.21 |

Source: George and King, Consumer Demand for Food Processing, 1971.

### b. Substitute Products

The principal substitutes for canned and frozen fruits, vegetables and juices are fresh fruits and vegetables. Although fresh products substitute for both canned and frozen forms of the same product, the substitution relationship between the fresh and frozen product is usually closer since the canned product is often cooked and may have seasoning (salt, etc.) or sweetness (e.g., peaches in heavy syrup) added.

Development of new fresh production areas coupled with the improvements which have occurred in truck, rail and air transport, plus new technology in fresh product preparation, packaging and refrigeration, now make it possible to buy fresh products nearly the year around throughout the United States. However, out-of-season fresh products must be transported greater distances (sometimes from Mexico, Central or South America) or must be produced under hot house conditions in colder climates. The result is higher prices and consumers turn to frozen or canned forms to save money. However, price is not the only consideration influencing the consumer in her choice between fresh and processed fruits and vegetables. Many canned or frozen products offer greater convenience, more consistent quality and preferred flavor for certain uses. Canned and frozen products are easier to keep on hand on the shelf or in the freezer and this gives the housewife a greater variety available in her home at any given time than would be possible if she were entirely dependent on fresh products.

There are some substitution relationships between canned and frozen vegetables and other classes of foods. Canned or frozen fruit can, and does, substitute as a dessert for such items as ice cream, cakes or puddings. As dietary habits have changed ( away from fats, oils and heavy desserts), there has been some substitution of fruits and vegetables, in terms of diet composition. However, this relationship is not close.

### c. Retail Price Elasticity

Retail price elasticity measures the responsiveness of demand to price changes. In a study by Brandow of Pennsylvania State University1/ the price elasticity of all fruits is identified as -.60 and for all vegetables at -.30.

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1/ Brandow, G.E., Interrelations Among Demands for Farm Products and Implications for Control of Market Supply, Bulletin No. 680, Pennsylvania State University 1961.

Table IV-10 presents retail demand elasticities, cross-elasticities and income elasticities for a variety of canned, fresh and frozen fruit and vegetable products. Additional elasticities have been estimated in the above reference but have not been included herein.

### d. Price Margin and Price Conditions for Selected Products

There is a considerable variation in prices, margins and farm value for processed fruits and vegetables. Most of the variation and fluctuations occur from one marketing year to another with moderated fluctuations and variations within the marketing year. Retail prices and retail and wholesale margins chacteristically fluctuate more frequently and with greater amplitude than do processor and grower prices and processor margins.

Retail prices, processor prices, farm values and total marketing margins have increased during the past few years. As a percentage of retail prices, however, farm value and marketing margin have been relatively constant. Price fluctuations have normally been shared by both the grower and the retail and wholesale marketing system. One noteable exception is citrus prices received by the grower which have fluctuated widely.

Retail prices, processor prices, farm values and processor margins associated with canned peaches, canned pears and frozen strawberries have not increased in recent years.

Table IV-11 and IV-12 present prices and margins for a variety of selected fruit and vegetable products.

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1/ George, P.S. and G.A. King, Consumer Demand for Food Commodities in the United States with Projections for 1980, California Agricultural Experiment Station, 1971.

Table IV-10. Selected fruit and vegetable demand and income elasticities

| | Frozen Fruits | Dried Fruits | Selected Canned Fruits | | Frozen Vege. | Dried Vege. | Selected Canned Vegetables | | | Other Canned Fruits & Vege. | Income |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peaches | Pine-apple | | | Corn | Tomatoes | Peas | | |
| Frozen Fruits | -1.0 | .003 | .013 | .0005 | .0009 | .001 | .002 | .001 | .002 | .009 | .147 |
| Dried Fruits | .0079 | .65 | .106 | .0001 | .0001 | .0001 | .0003 | .0001 | .0003 | .0003 | .661 |
| Selected Canned Fruits: | | | | | | | | | | | |
| Peaches | .0184 | .0641 | -.759 | .125 | .0004 | .0005 | .0009 | .0005 | .001 | .001 | .447 |
| Pineapples | .0011 | .0000 | .155 | -.826 | .00002 | .00003 | .00006 | .00003 | .00007 | .00007 | .315 |
| Frozen Vegetables | .001 | -.0001 | -.00004 | .000005 | -1.03 | .007 | .010 | .007 | .012 | .002 | .616 |
| Dried Vegetables | .003 | .0002 | .001 | .0003 | .015 | -.48 | .078 | .00000 | .024 | .0003 | .216 |
| Selected Canned Vege: | | | | | | | | | | | |
| Corn | .004 | .00006 | .001 | .0005 | .016 | .059 | -.255 | .00001 | .059 | .003 | .173 |
| Tomatoes | .003 | .0003 | .001 | .0003 | .015 | .00003 | .00000 | -.176 | .056 | .001 | .216 |
| Peas | .0005 | .00006 | .001 | .0005 | .016 | .014 | .047 | .033 | -.185 | .003 | .023 |
| Other Canned Fruits & Vegetables | .003 | .0001 | .001 | .0003 | .015 | .0004 | .0004 | .0002 | .0006 | -.40 | .200 |

Table IV-11. Growers, processors, and wholesaler-retail margins as a percentage of retail price - fruits

| | Year | Grower | Processor | Wholesale Retail | Total |
|---|---|---|---|---|---|
| Applesauce | 65-66 | 19 | 49 | 32 | 100 |
| Canned | 66-67 | 21 | 53 | 26 | 100 |
| (Eastern Retail | 67-68 | 24 | 53 | 23 | 100 |
| Prices, Eastern | 68-69 | 23 | 47 | 30 | 100 |
| Growers | 69-70 | 19 | 49 | 32 | 100 |
| Grapefruit Sections | 65-66 | 17 | 31 | 52 | 100 |
| Canned | 66-67 | 14 | 30 | 56 | 100 |
| Eastern Retail | 67-68 | 21 | 27 | 52 | 100 |
| Southern Production | 68-69 | 15 | 29 | 56 | 100 |
| | 69-70 | 16 | 29 | 55 | 100 |
| Grapefruit Juice | 65-66 | 28 | 38 | 34 | 100 |
| Canned | 66-67 | 19 | 37 | 44 | 100 |
| Eastern Retail | 67-68 | 32 | 28 | 40 | 100 |
| Southern Production | 68-69 | 22 | 35 | 43 | 100 |
| | 69-70 | 31 | 26 | 43 | 100 |
| Lemonade frozen | 65-66 | 14 | 40 | 46 | 100 |
| U.S. retail | 66-67 | 15 | 36 | 49 | 100 |
| Western Production | 67-68 | 17 | 35 | 48 | 100 |
| | 68-69 | 16 | 36 | 48 | 100 |
| | 69-70 | 14 | 37 | 49 | 100 |
| Orange juice canned | 65-66 | 25 | 40 | 35 | 100 |
| Eastern retail | 66-67 | 19 | 37 | 44 | 100 |
| Southern production | 67-68 | 35 | 29 | 36 | 100 |
| | 68-69 | 34 | 29 | 37 | 100 |
| | 69-70 | 26 | 38 | 36 | 100 |

Table IV-11. (continued)

| | Year | Grower | Processor | Wholesale Retail | Total |
|---|---|---|---|---|---|
| Orange juice frozen Concentrated U.S. retail Southern production | 65-66 | 40 | 34 | 26 | 100 |
| | 66-67 | 26 | 34 | 40 | 100 |
| | 67-68 | 43 | 29 | 28 | 100 |
| | 68-69 | 46 | 31 | 23 | 100 |
| | 69-70 | 35 | 34 | 31 | 100 |

## Table IV-12. Growers, processors, and wholesaler-retail, margins as a percentage of retail price - vegetable

| | Year | Grower | Processor | Wholesale Retail | Total |
|---|---|---|---|---|---|
| Asparagus canned | 65-66 | 30 | 29 | 41 | 100 |
| Eastern retail | 66-67 | 31 | 29 | 40 | 100 |
| Eastern production | 67-68 | 32 | 29 | 39 | 100 |
| | 68-69 | 31 | 33 | 36 | 100 |
| | 69-70 | 31 | 31 | 38 | 100 |
| Asparagus canned | 65-66 | 33 | 26 | 41 | 100 |
| Western retail | 66-67 | 36 | 25 | 39 | 100 |
| Western production | 67-68 | 32 | 27 | 41 | 100 |
| | 68-69 | 31 | 30 | 39 | 100 |
| | 69-70 | 31 | 30 | 39 | 100 |
| Asparagus frozen | 65-66 | 31 | 41 | 28 | 100 |
| Western retail | 66-67 | 35 | 37 | 28 | 100 |
| Western production | 67-68 | 33 | 37 | 30 | 100 |
| | 68-69 | 31 | 41 | 28 | 100 |
| | 69-70 | 31 | 41 | 28 | 100 |
| Spinach canned | 65-66 | 8 | 38 | 54 | 100 |
| Eastern retail | 66-67 | 8 | 37 | 55 | 100 |
| Eastern production | 67-68 | 8 | 37 | 55 | 100 |
| | 68-69 | 7 | 42 | 51 | 100 |
| | 69-70 | 7 | 46 | 47 | 100 |
| Spinach canned | 65-66 | 7 | 41 | 52 | 100 |
| Western retail | 66-67 | 7 | 40 | 53 | 100 |
| Western producer | 67-68 | 7 | 38 | 55 | 100 |
| | 68-69 | 7 | 43 | 50 | 100 |
| | 69-70 | 7 | 43 | 50 | 100 |

Table IV-12.(continued)

| | Year | Grower | Processor | Wholesale Retail | Total |
|---|---|---|---|---|---|
| Spinach frozen<br>Western retail<br>Western production | 65-66 | 8 | 58 | 34 | 100 |
| | 66-67 | 9 | 56 | 35 | 100 |
| | 67-68 | 8 | 59 | 33 | 100 |
| | 68-69 | 8 | 61 | 31 | 100 |
| | 69-70 | 8 | 55 | 37 | 100 |

## 2. Supply Characteristics of the Fruit and Vegetable Industry

The fruit and vegetable canning, freezing and dehydrating industries are supply-oriented in that the location of processing plants is dictated by the location of raw product production. Most fruits and vegetables are perishable or semi-perishable and for most products, the time-lag between harvesting and processing must be kept to a minimum to maintain high standards of product quality.

The diversity of products processed and the seasonal production requirements of basic fruit and vegetable crops, results in a widespread network of canning and freezing plants. Specific fruit or vegetable crops may be produced in more than one area at different seasons of the year.

Although a relatively small number of firms produces a relatively large percentage of the total pack, the production of these large, diversified packers is obtained from a large number of plants scattered throughout the principal producing areas. Although there is appreciable concentration of capacity in a few firms, there is widespread geographic dispersion of processing plants.

Partly as the result of shifts in the relative importance of raw product production areas, there is some lack of balance in capacity and utilization of capacity of processing facilities.

The industry has a high capacity to utilized large numbers of relatively low-skilled production workers, especially women, but at the same time demands a cadre of highly skilled technical, quality-control and managerial staff.

Production technology has changed substantially in recent years and plant obsolescence is an important factor, especially among small independent packers. There are appreciable economies of scale in production and as a result there is a continuing decrease in the number of operating plants.

### a. Types and Locations of Raw Materials

The fruit and vegetable canning and freezing industries are primarily oriented toward the location of supplies of fruits and vegetables processed. Other materials used, such as sugar, seasonings, cans, cartons, etc. are important but the raw product tonnage required and the perishable nature of fruits and vegetables make the location of raw materials of paramount importance.

Due to the diversity of products that are processed, however, there are canning and freezing plants in virtually every state in the nation. Some states possess only a small number or insignificant proportion of the total plants within the industry. For example, there are several Midwestern states that possess one or two small canning plants that process only a very limited number of specialized product. When considering the processing plants by specific product there is as a general rule, considerable geographical clustering of processing plants as a result of supply orientation. A prime example is the potato processors of Oregon and Idaho.

There is also a tendency toward geographical clustering by processing or marketing types. For example, dehydration is heavily concentrated in Western states due again to the fact that only specialized products are dehydrated while apple production areas tend to specialize by use or marketing type, i.e., the Pacific Northwest produces large quantities of apples for the fresh apple market while Eastern apple producing states specialize in the production of apples for processing.

The inauguration of mandatory industry pollution abatement standards can therefore be expected to adversely and disproportionately affect selected areas of the country.

b. Utilization of Plant Capacity

It is generally recognized that fruit and vegetable plants are currently operating at a level of less than full capacity. This has been shown to be an important cost or supply factor and will be simulated in Phase II by variable cash flows that have been developed for representative plants operating at 100 percent and 90 percent of plant capacity. Because the throughputs used are representative of actual average size, throughputs, plant sizes and operating costs will be adjusted upwards to represent, for example, a large sized plant operating at 90 percent capacity.

The economic implications of plant capacity and the effects of pollution abatement standards at various capacity levels will be reflected through the above procedures. The effects of plant utilization on return on invested capital have been demonstrated in an earlier study. For the small plant, returns were reduced from 14 percent to 7 percent when capacity utilization was was reduced from 100 percent to 75 percent. Similar results were obtained for the medium sized plant with the internal rate of returns decreasing from 26 to 18 percent and for the large plant returns dropped from 70 to 50 percent. Returns with treatment facilities were then reduced by about 7 percentage points for the small and medium sized plants and about 15 percentage points for the large plant.

### c. Length of Operating Season

Another critical supply or cost consideration in the fruit and vegetable processing industry is length of operating season. Because raw product availability is limited to specific short seasons, a single line plant may operate for as little as 2 months. Other multiproduct firms may operate for as long as 9 months or more. With secondary processing, the plant may be operated on nearly a year-around basis.

Much effort is made to extend the annual operating season by hauling raw product from the south early in the year and/or hauling from the north late in the season. By processing a variety of products the season may be extended. Also by operating on a 2 shift per day basis - or even 3 shifts per day - the effect of a longer season is obtained.

## 3. Pricing

### a. Market Competition and Price Determination

Although the fruit and vegetable canning and freezing industries are characterized by the existence of large, multiproduct, multi-plant firms, where a relatively small number of firms process a high proportion of the total output, the industry is nevertheless highly competitive. There are a large number of small canners and freezers and the industry is faced with the necessity of selling a high proportion of its total pack to large national food chains. Plants and firms located in any region are potential competitors to those producing the same product lines in all other regions.

Market information on current packs, carryover stocks and current prices is readily available so that all segments of the industry operate from a position of reasonable knowledge of market conditions.

Products are relatively standardized and are bought and sold by grade. Once a canning season is underway and prices have found the level dictated, in part, by supply conditions and known pack and stocks, prices are relatively stable as compared to many other industries.

An increasing proportion of the total pack is being sold under private label where packers must meet buyer specifications and compete on a bid-price basis.

Competition tends to be centered around national brands, quality and merchandising services more than on price in a given year. Non-price competition includes credit or cash discounts, merchandising services and promotional allowances, but even these forms of competition tend to be standardized.

Strong national trade associations in both the canning and freezing industries serve both large and small packers and provide market information and services to their members.

In summary, the fruit and vegetable canning and freezing industries operate within a stable but competitive industry climate. Prices are determined by pack, stocks and national economic conditions rather than by oligopolistic price management at one extreme or by cut-throat competition at the other.

Some specific products have demonstrated greater historical variations and/or fluctuations in prices and margins at all levels -- grower, wholesale and retail. As a general rule, however, packs, stocks heavily influence the determination of fruit and vegetable canned and frozen prices.

Historical grower, process, wholesale and retail prices and margins were presented in Table IV-11. .

## B. Expected Price Changes

If the industry is successful in passing all pollution abatement costs forward to the consumer, the expected increase in price would amount to approximately 1 to 2 percent based upon earlier abatement strategy levels.1/ This would result in little impact in consumption patterns of the consumer. In a study by Brandow of Pennsylvania State University and previously cited--the price elasticity for all fruits is identified as -.60 and for all vegetables at -.30. This means that a 1 percent increase in price will

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1/ Agri Division, Dunlap & Assoc., "Economic Impact of Environmental Controls on the Fruit and Vegetable Canning and Freezing Industry." A report for the Council on Environmental Quality, November, 1971.

result in .6 percent and .3 percent decreases in consumption, respectively. Total per capita consumption of processed fruits is approximately 67 pounds and is expected to climb to 70-75 pounds in 1980; and total per capita consumption of processed vegetables is now 115 pounds with an expected growth to 120-130 pounds by 1980. Thus, if all costs were passed forward, a resultant decrease of 0.5 to 1.0 percent of approximately 1 to 2 pounds per capita could be expected. This would be less than the total annual increase in consumption resulting from population expansion and projected increases in per capita consumption.

### i. Projected Plant Utilization

On the basis of the earlier study cited above, plant shutdowns were projected to occurr heavily within the small and medium size categories. This would be largely for firms which have not as yet installed pollution abatement equipment and do not have access to low cost facilities.

Because of rather wide-spread underutilization of total capacity in the industry, it is not expected generally that marginal firms will attempt to expand their existing facilities to achieve desired economies of scale; the competitive structure of the industry will influence outward migration of firms thus increasing the rate of firm closures that has been occurring over the past 3 decades.

### ii. Projected Price Response

The ability to pass forward all price increases depends upon many factors such as demand, margin, substitute products and other factors. In the fruit and vegetable processing industry we have seen a historical trend for a decrease in the farm margin and processor margin for many of the canned fruits and vegetables, however, for frozen citrus juices and other products which are increasing in per capita consumption, the farm margin as a percent of retail costs have decreased while processor margins have increased. Thus, it would appear that there will be differential responses by commodity.

Processors may have more difficulty passing forward increased processing cost for products with stable demand than with products with rising demand such as citrus juices.

As a general rule, it is believed that the grower margins are sufficiently small to prevent a backward price movement. The bulk of the price effects are therefore expected to precipitate in the form of increased consumer prices with processors absorbing some of the increase for commodities with stable demand trends. There may be some very minor price absorption at the wholesale and retail levels for specific products.

iii. Locational Impact

Many of the marginal processing plants likely to be affected adversely by pollution abatement controls are located in areas or regions of the country that are already relatively economically depressed. Processor, grower and associated businesses are generally a major component of local economic development in these areas; and, consequently, any appreciable impact on these businesses will also impact the entire local economy via indirect multiplier effects on area incomes, employment, sales, level of trade, etc. Such effects are likely to be far more consequential in aggregate than the direct impacts of pollution abatement on the industry itself.

iv. Secondary Impact

Growth. Aggregate demand growth will likely only be dampened as a a consequence of pollution abatement costs and expected higher retail prices. Population growth is expected to quickly offset any short-run declines in per capita consumption.

Fresh Product Competition. Fresh fruits and vegetables pose little threat as substitutes for processed products. Because of convenience in preparation of processed commodities, they have been steadily gaining on fresh. With the relatively small expected rise in price for processed commodities this trend is not expected to be reversed. This is, of course, on an industry-wide basis.

Imports of Processed Fruits and Vegetables. The impact of increased imports of processed fruits and vegetables associated with anticipated increased costs of domestic processed products, is generally expected to be limited. With the exception of substantial imports of processed mushrooms and tomato products, imports of vegetables are negligible and would not be expected to increase materially. Apple juice, frozen strawberries, pineapple products and frozen blueberries are the principal fruit products imported . Production areas for pineapple and blueberries are limited in the United States and import of tomato products from Italy and Spain is, in part, associated with style of pack. Frozen strawberries from Mexico are a major competitive item and increased costs could reduce the competitive position of U.S. frozen strawberries.

However, both U.S. producers of raw products and U.S. processors are large and highly mechanized as compared to foreign suppliers and in spite of increased costs of pollution abatement, it is probably that the overall increase of imports would be small.

# V. ECONOMIC IMPACT ANALYSIS METHODOLOGY

The following economic impact analysis utilizes the basic industry information developed in Chapters I-IV plus the pollution abatement technology and costs provided by Environmental Protection Agency. The impacts examined include:

Price effects
Financial effects
Production effects
Employment effects
Community effects
Other effects

Due to the crucial nature of potential plant shutdowns (financial and production effects) to the other impacts, a disproportionate amount of time will be devoted to the financial and plant closure analysis.

In general, the approach taken in the impact analysis is the same as that normally done for any feasibility capital budgeting study of new investments. In the simplest of terms, it is the problem of deciding whether a commitment of time or money to a project is worthwhile in terms of the expected benefits derived. This decision process is complicated by the fact that benefits will accrue over a period of time and that in practice the analyst is not sufficiently clairvoyant nor physically able to reflect all of the required information, which by definition must deal with projections of the future, in the cost and benefit analysis. In the face of imperfect and incomplete information and time constraints, the industry segments were reduced to money relationships insofar as possible and the key non-quantifiable factors were incorporated into the analytical thought process to modify the quantified data. The latter process is particularly important in view of the use of model plants in the financial analysis. In practice, actual plants will deviate from the model and these variances will be considered in interpreting financial results based on model plants.

## A. Fundamental Methodology

Much of the underlying analysis regarding prices, financial and production effects is common to each kind of impact. Consequently, this case methodology is described here as a unit with the specific impact interpretations being discussed under the appropriate heading following this section.

The core analysis for this inquiry was based upon synthesizing physical and financial characteristics of the various industry segments through model or representative plants. The estimated cash flows for these model plants are summarized in Chapter III. The primary factors involved in assessing the financial and production impact of pollution control are profitability changes, which are a function of the cost of pollution control and the ability to pass along these costs in higher prices. Admittedly, in reality, closure decisions are seldom made on a set of well defined common economic rules, but also include a wide range of personal values, external forces such as the ability to obtain financing or considering the production unit as an integrated part of a larger cost center where total center must be considered.

Such circumstances include but are not limited to the following factors:

1. There is a lack of knowledge on the part of the owner-operator concerning the actual financial condition of the operation due to faulty or inadequate accounting systems or procedures. This is especially likely to occur among small, independent operators who do not have effective cost accounting systems.

2. Plant and equipment are old and fully depreciated and the owner has no intention of replacing or modernizing them. He can continue in production as long as he can cover labor and materials costs and/or until the equipment deteriorates to an irrepairable and inoperative condition.

3. Opportunities for changes in the ownership structure of the plants (or firms) exist through acquisition by conglomerates, large diversified firms, or through other acquisition circumstances which would permit re-evaluation of assets or in situations where new ownership may be willing to accept temporary low returns with the expectation that operations can be returned to profitable levels.

4. Personal values and goals associated with business ownership that override or ameliorate rational economic rules is this complex of factors commonly referred to as a value of psychic income.

5. The plant is a part of a larger integrated entity and it either uses raw materials being produced profitably in another of the firm's operating units wherein an assured market is critical or, alternatively, it supplies raw materials to another of the firm's operations wherein the source of supply is critical. When the profitability of the second operation offsets the losses in the first plant, the unprofitable operation may continue indefinitely because the total enterprise is profitable.

6. The owner-operator expects that losses are temporary and that adverse conditions will dissipate in the future. His ability to absorb short-term losses depends upon his access to funds, through credit or personal resources not presently utilized in this particular operation.

7. There are very low (approaching zero) opportunity costs for the fixed assets and for the owner-operator's managerial skills and/or labor. As long as the operator can meet labor and materials costs, he will continue to operate. He may even operate with gross revenues below variable costs until he has exhausted his working capital and credit.

8. The value of the land on which the plant is located is appreciating at a rate sufficient to offset short-term losses, funds are available to meet operating needs and opportunity costs of the owner-operator's managerial skills are low.

The above factors, which may be at variance with common economic decision rules, are generally associated with proprietorships and closely held enterprises rather than publicly held corporations.

While the above factors are present in and relevant to business decisions, it is argued that common economic rules are sufficiently universal to provide a useful and reliable insight into potential business responses to new investment decisions, as represented by required investment in pollution control facilities. Thus, economic analysis will be used as the core analytical procedure. Given the pricing conditions, the impact on profitability (and possible closure) can be determined by simply computing the ROI (or any other profitability measure) under conditions of the new price and incremental investment in pollution control. The primary consequence of profitability changes is the impact on the plant regarding plant shutdown rather than making the required investment in meeting pollution control requirements.

In the most fundamental case, a plant will be closed when variable expenses ($Vc$) are greater than revenues ($R$) since by closing the plant, losses can be avoided. However, in practice plants continue to operate where apparently $Vc > R$. Reasons for this include:

- lack of cost accounting detail to determine when $Vc > R$.
- opportunity cost of labor or some other resource is less than market values. This would be particularly prevalent in proprietorships where the owner considers his labor as fixed.
- other personal and external financial factors.
- expectations that revenues will shortly increase to cover variable expenses.

A more probable situation is the case where $Vc < R$ but revenues are less than variable costs plus cash overhead expenses ($TCc$) which are fixed in the short run. In this situation a plant would likely continue to operate as contributions are being made toward covering a portion of these fixed cash overhead expenses. The firm cannot operate indefinitely under this condition, but the length of this period is uncertain. Basic to this strategy of continuing operations is the firm's expectation that revenues will increase to cover cash outlay. Factors involved in closure decisions include:

- extent of capital resources. If the owner has other business interests or debt sources that will supply capital input, the plant will continue.
- lack of cost accounting detail or procedures to know that $TCc > R$, particularly in multiplant or business situation.
- labor or other resources may be considered fixed and the opportunity cost for these items is less than market value.

Identification of plants where $TCc > R$, but $Vc < R$ leads to an estimate of plants that should be closed over some period of time if revenues do not increase. However, the timing of such closures is difficult to predict.

The next level of analysis, where $TCc < R$, involves estimating the earnings before and after investment in pollution abatement. So long as $TCc \quad R$ it seems likely that investment in pollution control will be made and plant operations continued so long as the capitalized value of earnings (CV), at the firms (industry) cost of capital, is greater than the scrap or salvage value (S) of the sunk plant investment. If $S > CV$, the firm could realize S in cash and reinvest and be financially better off. This presumes reinvesting at least at the firms (industry) cost of capital.

Computation of CV involves discounting the future earnings flow to present worth through the general discounting function:

$$V = \sum_{n=1}^{t} A_n (1+i)^{-n}$$

where

$V$ = present value
$A_n$ = a future value in $n^{th}$ year
$i$ = discount rate as target ROI rate
$n$ = number of conversion products, i.e., 1 year, 2 years, etc.

It should be noted that a more common measure of rate of return is the book rate, which measures the after-tax profits as a ratio of invested capital, is net worth or sales. These ratios should not be viewed as a different estimate of profitability as opposed to DCF measures (discounted cash flow) but rather an entirely different profitability concept. The reader is cautioned not to directly compare the DCF rates with book rates. Although both measures will be reported in the analyses, the book rate is reported for informational purposes only.

The two primary types of DCF measures of profitability are used. One is called the internal rate of return or yield and is the computed discount rate (yield) which produces a zero present value of the cash flow. The yield is the highest rate of interest the investor could pay if all funds were borrowed and the loan was returned from cash proceeds of the investment. The second DCF measure is the net present value concept. Rather than solve for the yield, a discount rate equivalent to the firms cost of capital is used. Independent investments with net present values of above zero are accepted; those below zero are rejected. The concept of comparing capitalized earnings with the sunk investment value is a variation of the net present value method.

The data input requirements for book and DCF measures are derived, to a large extent, from the same basic information although the final inputs are handled differently for each.

## 1. Benefits

For purposes of this analysis, benefits for the book analysis have been called after-tax income and for the DCF analysis after-tax cash proceeds. The computation of each is shown below:

$$\text{After tax income} = (1 - T) \times (R - E - I - D)$$

$$\text{After tax cash proceeds} = (1 - T) \times (R - E - D) + D$$

where

T = tax rate

R = revenues

E = expenses other than depreciation and interest

I = = interest expense

D = depreciation charges

Interest in the cash proceeds computation is omitted since it is reflected in the discount rate, which is the after-tax cost of capital, and will be described below. Depreciation is included in the DCF measure only in terms of its tax effect and is then added back so that a cash flow over time is obtained.

A tax rate of 48 percent was used throughout the analysis. Accelerated depreciation methods, investment credits, carry forward and carry back provisions were not used due to their complexity and special limitations. It is recognized that in some instances the effective tax rate may be lower in a single plant situation, but the firm's tax rate will be close to the 48 percent rate.

Revenue, expenses, interest and depreciation charges used were those discussed in Chapter III and Chapter VI for pollution control facilities. These items were assumed to constant over the period of analysis.

## 2. Investment

Investment is normally thought of as outlays for fixed assets and working capital. However, in evaluating closure of an on-going plant where the basic investment is sunk, the value of that investment must be made in terms of its liquidation or salvage value, that is its opportunity cost or shadow price. [1] For purposes of this analysis, sunk investment was taken as the sum of equipment salvage value plus land at current market value plus the value of the net working capital (current assets less current liabilities) tied up by the plant (see Chapter III for values). This same amount was taken as a negative investment in the terminal year. Replacement investment for plant maintenance was taken as equal to annual depreciation, which corresponds to operating policies of some managements and serves as a good proxy for replacement in an on going business.

Investment in pollution control facilities was taken as the estimates provided by EPA and shown in Chapter VI. Only incremental values were used, to reflect in-place facilities. Only the value of the involved land was taken as a negative investment in the terminal year.

The above discussion refers primarily to the DCF analysis. Investment used in estimating book rates was taken as invested capital - book value of assets plus net working capital. In the case of new investment, its book rate was estimated as 50 percent of the original value.

## 3. Cost of Capital - After Tax

Return on invested capital is a fundamental notion in U.S. business. It provides both a measure of actual performance of a firm as well expected performance. In this latter case, it is also called the cost of capital. The cost of capital is defined as the weighted average of the cost of each type of capital employed by the firm, in general terms equities and interest bearing liabilities. There is no methodology that yields the precise cost of capital, but it can be approximated within reasonable bounds.

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[1] This should not be confused with a simple buy sell situation which merely involves a transfer of ownership from one firm to another. In this instance, the opportunity cost (shadow price) of the investment may take on a different value.

The cost of capital was determined for purposes of this study by examining Troy's Financial Almanac and industry provided data. The weights of the two respective types capital were estimated at 60 percent debt and 40 percent equity. The cost of debt was assumed to be 8 percent. The cost of equity was determined from the ratio of before tax income to net worth and estimated at 16.5 percent.

To determine the weighted average cost of capital, it is necessary to adjust the before tax costs to after tax costs. This is done by multiplying the costs by one minus the tax rate (assumed to be 48 percent, the marginal federal income tax rate).

Weighted Average Cost of Capital

| Item | Weight | Before tax cost | Tax Rate | After tax cost | Weighted cost | |
|---|---|---|---|---|---|---|
| Debt | .60 | .08 | .48 | .0416 | .02496 | |
| Equity | .40 | .165 | .48 | .0858 | .03432 | |
| | | | | | .05928 | .06 |

As shown in the above computation, the estimated after tax cost of capital is 7.0 percent. (The before tax costs were compiled from several sources and are assumed to be representative of the industry.)

## 4. Construction of the Cash Flow

A twenty-two period cash flow was used in this analysis and was constructed as follows:

1. Sunk investment (salvage market value of fixed assets plus net working capital) taken in year $t_0$.
2. After tax cash proceeds taken for years $t_1$ to $t_{20}$.
3. Annual replacement investment, equal to annual current depreciation taken for years $t_1$ to $t_{20}$.
4. Terminal value equal to sunk investment taken in year $t_{21}$.

5. Incremental pollution control investment taken in year $t_o$ for 1977 standards and year $t_6$ for 1983 standards.

6. Incremental pollution expenses taken for years $t_1$ to $t_{20}$ for 1977 standards and years $t_7$ to $t_{20}$ for 1983 standards.

7. No replacement investment taken on baseline pollution investment on assumption of 20-year useful life.

8. Terminal value of pollution facilities are assumed equal to zero in year $t_{21}$.

## B. Price Effects

At the outset, it must be recognized that price effects and production effects are intertwined with one effect having an impact upon the other. In fact, the very basis of price analysis is the premise that prices and supplies (production) are functionally related variables which are simultaneously resolved.

Solution of this requires knowledge of demand growth, price elasticities, supply elasticities, the degree to which regional markets exist, the degree of dominance experienced by large firms in the industry, market concentration exhibited by both the industry's suppliers of inputs and purchasers of outputs, organization and coordination within the industry, relationship of domestic output with the world market, existence and nature of complementary goods, cyclical trends in the industry, current utilization of capacity and, exogenous influences upon price determination (e. g., governmental regulation).

In view of the complexity and diversity of factors involved in determination of the market price, a purely quantitative approach to the problem of price effects is not feasible. Hence, the simultaneous considerations suggested above will be made. The judgment factor will be heavily employed in determining the supply response to a price change and alternative price changes to be employed.

As a guide to the analysis of price effects, the estimated price required to leave the model plant segment as well off will be computed. The required price increase at the firm level will be evaluated in light of the relationship of the model plant to the industry and the understanding of the competitive position of the industry. The required price increase can be readily computed using the DCF analysis described above, but dealing only with the incremental pollution investment and cash proceeds.

Application of the above DCF procedure to these costs will yield the present value of pollution control costs (i.e., investment plus operating cost less tax savings). If this is known, the price increase required to pay for pollution control can readily be calculated by the formula

$$X = \frac{(PVP)\,(100)}{(1-T)\,(PVR)}$$

where:

X = required percentage increase in price

PVP = present value of pollution control costs

PVR = present value of gross revenue starting in the year pollution control is imposed

Note that this formula implies that incremental profits resulting from the price increase will be taxed at a rate of 48 percent.

## C. Financial Effects

In Chapter II, the financial characteristics of model plants were presented. These data will serve as the base point for the analysis of financial effects of pollution control. The primary focus of analysis will be upon profitability in the industry and the ability of the firms to secure external capital. Hence, it is obvious that this portion of the analysis cannot be divorced from production effects since profit levels and the ability to finance pollution abatement facilities will have a direct influence on supply responses -- utilization of capacity and plant closures.

The measures of profitability utilized will include after-tax book rate of return on invested capital and cash flow (after-tax profit plus depreciation) will be measured. After-tax profit as a percent of sales will also be reported to assist in comparing financial data with standard industrial measures.

## D. Production Effects

Potential production effects include reductions of capacity utilization rates, plant closures and stagnation of industry growth. It is anticipated that reductions in capacity utilization will be estimated via qualitative techniques given the analysts' knowledge of the industry. The same is true for assessing the extent to which plant closures may be offset by increases in capacity utilization on the part of plants remaining in operation. Data limitations and time constraints are expected to require that the impact of pollution control standards upon future growth of the industry also be estimated via qualitative methods.

The remaining effect, plant closures, is very difficult to measure realistically as discussed above in Section A. As a starting point in the plant closure analysis, a shutdown model will be employed to indicate which model plants should be closed, the marginal operations and the sound operations. These conclusions will be based upon the decision rule that a plant will be closed when the net present value of the cash flow is less than zero.

The above analysis will be done under a without pollution control condition and a with pollution control condition. The former (and including historical trends) will establish a baseline against which total closures after pollution control will be compared, to arrive at an estimate of closures due to pollution control.

## E. Employment Effects

Given the production effects of estimated production curtailments, plant closings and changes in industry growth, a major consideration arises in the implications of these factors upon employment in the industry. The employment effects stemming from each of these production impacts will be estimated. To the extent possible, the major employee classifications involved will be examined as will the potential for re-employment.

## F. Community Effects

The direct impacts of job losses upon a community are immediately apparent. However, in many cases, plant closures and cutbacks have a far greater impact than just the employment loss. Multiplier effects may result in even more unemployment. Badly needed taxes for vital community services may dwindle. Community pride and spirit may be dampened. However, in some cases, the negative community aspects of production effects may be very short-term in nature with the total impact barely visible from the viewpoint of the overall community. In a few cases, the closure of a plant may actually be viewed as a positive net community effect (e.g., a small plant with a high effluent load in an area with a labor shortage).

These impact factors will be qualitatively analyzed as appropriate.

## G. Other Effects

Other impacts such as direct balance of payments effects will also be included in the analysis. This too will involve qualitative analyses.

## VI. POLLUTION CONTROL REQUIREMENTS AND COSTS

Water pollution control requirements and costs used in this analysis were furnished by the Effluent Guidelines Division of the Environmental Protection Agency from materials developed by the Ben Holt Company.[1/] These basic data covered selected types of apple, citrus and potato processing plants in the fruit and vegetable processing industry, and this information was adapted to the types and sizes of processing plants specified in this analysis.[2/]

Three effluent control levels were considered in the information provided:

| | | |
|---|---|---|
| BPT | - | Best Practicable Control Technology Currently Available, to be achieved by July 1, 1977 |
| BAT | - | Best Available Pollution Control Technology Economically Achievable, to be achieved by July 1, 1983 |
| NSPS | - | New Source Performance Standards, apply to any source for which construction starts after the publication of the proposed regulations for the Standards |

No pretreatment controls were estimated to be required for the types of plants included in this study.

### A. Categories of Canned and Preserved Fruits and Vegetable Plants

Information regarding the standards of performance and costs for achieving said standards was provided by EPA. Data were provided for large and small plants categorized as follows:

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[1/] Development Document for Effluent Limitations Guidelines and Standards of Performance--Canned and Preserved Fruits and Vegetables Industry, Draft Report, The Ben Holt Company, July, 1973.

[2/] Pollution control guidelines and treatment costs were not provided for spinach and asparagus products. Hence, no further analysis is presented herein.

Citrus Products
Apple Juice
Apple Products, except Juice
Frozen Potatoes
Dehydrated Potato Products

These data, however, did not coincide with the model plant data developed in Phase I of this report and were modified accordingly. The model plant structure used in this report consisted of the following plants in small, medium, and large size categories: [1]

Frozen Orange Juice Concentrate
Single Strength Orange Juice
Apple Juice
Apple Slices
Apple Sauce

An extensive search was made to obtain information regarding the potato processing industry, but because information regarding revenue, production cost, profits and investment is closely held, we were unable to develop sufficient economic information regarding frozen and dehydrated potato plants to include them in this analysis (Chapter III).[2]

The above categories of plants were evaluated separately from the standpoint of establishing effluent limitation guidelines which are described in the following section.

## B. Effluent Limitation Guidelines

Specific effluent limitation guidelines were provided by EPA, as recommended by Ben Holt, Inc., for inclusion in this study. Two levels of control were recommended: (1) BPT--Best Practicable Control Currently Available (1977), and (2) BAT--Best Available Technology Economically Achievable (1983). The NSPS--New Source Performance Standards, were set equal to the BAT guidelines. No pretreatment standards were provided and are not estimated to be required in the industry segments studied.

For reference, the recommended BPT and BAT guidelines to be met by the industry segments involved in this study are as shown in Table VI-1 and VI-2. The types of treatment which are proposed to achieve the effluent limitations indicated are described briefly in the following section. Alternative treatment strategies are available to achieve both the BPT and BAT guidelines.

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[1] Single-product model plants were developed given available secondary data. Multi-product plants are common, but numerous product combinations and volume-mixes exist. Single-product plants were assumed to best reflect the general magnitude of impact involved.

[2] Potato processing model plant data was unobtainable within the scope of study. A preliminary impact assessment for potatoes is contained in Appendix A.

Table VI-1. Recommended BPT (Best Practicable Control Technology) effluent limitation guidelines for selected fruit and vegetable processing plants[1/]

| PLANT SUBCATEGORY | BOD5 (kg/kkg) | SUSPENDED SOLIDS (kg/kkg) |
|---|---|---|
| APPLES: Slices and Sauce (Both Small & Large Plants) | 0.35 | 0.25 |
| APPLES: Juice (Both Small & Large Plants) | 0.25 | 0.15 |
| CITRUS: Juice, Oil, Segments | | |
| Plant Capacity Less Than 370 kkg/D | 0.30 | 0.15 |
| Plant Capacity Greater Than 370 kkg/D | 0.25 | 0.15 |
| CITRUS: Peel Products (Both Small & Large Plants) | 0.20 | 0.20 |
| CITRUS: Juice, Oil, Segments, Peel Products (Both Small & Large Plants) | 0.25 | 0.25 |
| POTATOES: Dehydrated Products (Both Small & Large Plants) | 0.60 | 1.20 |
| POTATOES: Frozen Products | | |
| Plant Capacity Less Than 320 kkg/D | 1.00 | 1.50 |
| Plant Capacity Greater Than 320 kkg/D | 0.95 | 1.50 |

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[1/] Source: EPA and the Ben Holt Company, Inc.

Table VI-2. Recommended BAT (Best Available Technology Economically Achievable) effluent limitation guidelines for selected fruit and vegetable processing plants[1]

| PLANT SUBCATEGORY | | BOD5 (kg/kkg) | SUSPENDED SOLIDS (kg/kkg) |
|---|---|---|---|
| APPLES: | Slices and Sauce | 0.07 | 0.04 |
| APPLES: | Juice | 0.02 | 0.02 |
| CITRUS: | Juice, Oil, Segments | 0.03 | 0.01 |
| CITRUS: | Peel Products | 0.01 | 0.01 |
| CITRUS: | Juice, Oil, Segments and Peel Products | 0.03 | 0.01 |
| POTATOES: | Dehydrated Products | 0.15 | 0.13 |
| POTATOES: | Frozen Products | 0.21 | 0.15 |

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[1] Source: EPA and the Ben Holt Company, Inc.

## C. Pollution Control Requirements

To achieve the effluent limitations as proposed above, the fruit and vegetable processing industry is likely to apply a variety of treatment strategies. A number of alternatives were presented by EPA (Ben Holt Co.); and these alternatives are briefly described in Table VI-3. As indicated in the table, alternatives B and E are suggested to meet the BPT guidelines. Alternatives C, F and G are suggested to meet the BAT guidelines. Also, alternative D (spray irrigation) is indicated to provide treatment to meet both the BPT and BAT guidelines if it can be applied. It is further noted that B to C and E to F or G are logical combinations to first meet BPT and then the BAT guidelines.

Not all plants are expected to be able to use the least costly system (estimated costs are shown below) based primarily on land availability -- either for lagoons or spray irrigation. In Table VI-9 below, selected combinations of treatment strategies which may be used are estimated.

## D. Pollution Control Costs

Pollution control cost estimates were provided by EPA (from Supplement A of the Development Document prepared by the Ben Holt Co.) for selected plants (small and large) in each of the principal categories defined above, i.e., apple juice, apple products except juice and citrus products. Pollution control investment and operating cost data were included for alternative treatment practices within each category, i.e. alternatives B, C, D, E, F and G, which correspond to the BPT and BAT effluent reduction guidelines as has been indicated.

Based upon data available, DPRA generated additional investment and operating cost data in the form desired for this study. In particular, data corresponding to different sizes of plants within each category of processing plants were desired. A summary of the estimated pollution control costs for the various categories and sizes of plants as used in this study are as shown in Table VI-4.

The method used to develop the cost data in Table VI-4 involved linear interpolation and extrapolation of investment and annual operating cost data provided. That is, data received were for small and large plants of specified sizes (in tons per day). DPRA model plants (small, medium and large) were of different sizes ranging from smaller to larger than those for which data were estimated. Insufficient information was available to establish non-linear relationships of investment and annual operating costs by size; therefore, linear functions were assumed to approximate the costs for this study.

Table VI-3 Summary of treatment components for alternative strategies of effluent reduction: Apple Juice Only, Apple Products except Juice, and Citrus Products [1]

| Treatment Component | Alternative Strategies for Apple Juice Only | | | | | | Alternative Strategies for Apple Products except Juice | | | | | | Alternative Strategies for Citrus Products | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B | C | D | E | F | G | B | C | D | E | F | G | B | C | D | E | F | G |
| Screening (Level A) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Primary Sedimentation | | | | | | | | | | | | | | | | | | |
| Cooling Tower | | | | | | | | | | | | | X | | | X | X | X |
| Shallow Lagoon (30 day) | | | X | | | | | X | X | | | | | X | X | | | |
| Aerated Lagoon--Settling | | X | | | | | | X | | | | | X | X | | | | |
| Aerated Lagoon--No Settling | X | X | | | | X | X | X | | | | X | X | X | | | | X |
| Anaerobic/Aerobic Lagoon | | | | | | | | | | | | | | X | | | | |
| Activated Sludge | | | | X | X | X | | | | X | X | X | | | | X | X | X |
| Sand Filtration | | | | | X | X | | | | | X | X | | | | | X | X |
| Spray Irrigation | | | X | | | | | | X | | | | | | X | | | |

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[1] Source: EPA and the Ben Holt Co., Inc. Levels B and E are alternative BPT control strategies, levels C, F and G are alternative BAT control strategies, level D provides both BPT and BAT effluent reductions.

Table VI-4. Estimated Investment (I) and Annual Costs (AC) for Best Practicable Control Technology (BPT) and Best Available Control Technology (BAT) for wastewater effluent treatment for selected plants in the fruit and vegetable processing industry ($1,000)

| | | | Alternative Effluent Reduction Strategies | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | B (BPT) | | C (BAT) | | D (BOTH) 1/ | | E (BPT) | | F (BAT) | |
| Type of Plant | Category | Tons/day | I | AC | I | AC | I | AC | I | AC | I | AC |
| **Citrus** | | | | | | | | | | | | |
| Frozen Conc. Or.Ju. | S | 144 | 201 | 42 | 423 | 87 | 208 | 48 | 620 | 37 | 709 | 50 |
| Frozen Conc. Or.Ju. | M | 528 | 276 | 53 | 578 | 110 | 363 | 84 | 862 | 53 | 984 | 69 |
| Frozen Conc. Or. Ju. | L | 1,072 | 382 | 68 | 797 | 114 | 583 | 136 | 1,205 | 75 | 1,374 | 96 |
| Single Strength Or.Ju. | S | 54 | 184 | 40 | 387 | 82 | 172 | 39 | 563 | 33 | 644 | 46 |
| Single Strength Or.Ju. | M | 109 | 195 | 41 | 409 | 85 | 194 | 44 | 597 | 36 | 684 | 48 |
| Single Strength Or.Ju. | L | 272 | 226 | 46 | 475 | 95 | 260 | 60 | 700 | 42 | 800 | 57 |
| **Apples** | | | | | | | | | | | | |
| Canned Slices | S | 32 | 24 | 17 | 58 | 41 | 37 | 8 | 215 | 8 | 249 | 15 |
| Canned Slices | M | 64 | 28 | 25 | 66 | 42 | 43 | 10 | 228 | 9 | 263 | 16 |
| Canned Slices | L | 69 | 32 | 33 | 74 | 43 | 49 | 12 | 241 | 10 | 277 | 17 |
| Canned Sauce | S | 32 | 24 | 17 | 58 | 41 | 37 | 8 | 215 | 8 | 249 | 15 |
| Canned Sauce | M | 64 | 28 | 25 | 66 | 42 | 43 | 10 | 228 | 9 | 263 | 16 |
| Canned Sauce | L | 96 | 32 | 33 | 74 | 43 | 49 | 12 | 241 | 10 | 277 | 17 |
| Canned Juice | S | 48 | 9 | 3 | 16 | 8 | 17 | 3 | 136 | 4 | 155 | 10 |
| Canned Juice | M | 96 | 13 | 4 | 22 | 10 | 25 | 5 | 151 | 5 | 174 | 11 |
| Canned Juice | L | 144 | 17 | 5 | 29 | 12 | 33 | 7 | 166 | 6 | 193 | 12 |

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1/ Alternative D, Spray Irrigation, is estimated to meet both the BPT and BAT guidelines.

For reference, the linear functional relationships used to generate the pollution control investment and annual costs used in the impact analysis are as shown in Tables VI-5 to VI-7. The equations were derived given the two data points (small plant and large plant, as shown) provided both for investment and annual costs.

## E. Status of Wastewater Treatment

Approximately two-thirds of the plants in the citrus and apple processing industries have either tie-ins with municipal systems or have land-irrigation waste disposal systems (Table VI-8). In either case, further treatment requirements are not expected in terms of the limitation guidelines of this study.

The remaining one-third of these industries have only partial treatment or no treatment facilities at the present time. Some plants in this group are believed to currently meet the BPT guidelines based on information provided, but no specific estimate is known. However, further treatment is expected to be required by essentially all (99 percent) of these plants in order to meet the BAT (1983) guidelines.

In Table VI-8, a more detailed summary of the status of wastewater treatment in the citrus, apple and potato processing industries is shown. These data are sample data only, but they are assumed to reflect the status of the industry categories shown. Further information was sought but not found available regarding the status of all plants in the industry.

Because alternative treatment strategies are available, a further estimate is needed of which treatment strategies will be employed to meet the BPT and BAT guidelines (including potential hook-up with municipal systems). According to information supplied by EPA, the schedules shown in Table VI-9 are used herein.

Given the estimated current treatment status of citrus and apple products processing plants as summarized in Table VI-8, and given the estimated schedules of treatment strategies for plants which are not presently on municipal or land disposal systems as indicated in Table VI-9, then it is possible to project distributions of treatment practices for 1977 and 1983 as shown in Table VI-10. That is, the estimated distributions of treatment alternatives to meet the BPT (1977) and BAT (1983) proposed standards are as indicated.

Table VI-5. Summary of investment (I) and annual cost (AC) data for selected citrus products plants. And estimated linear cost relationships for alternative treatment practices

| Treatment Practice and Type Cost | | Plant Data 1/ | | Linear Cost Fcn: 2/ Y=a+bX | |
|---|---|---|---|---|---|
| | | 400 TPD(S) | 4,000 TPD(L) | 'a' | 'b' |
| | | ($000) | ($000) | | |
| Treatment B: | I | 251.2 | 950.2 | 173.5 | .1942 |
| | AC | 49.7 | 151.2 | 38.4 | .0282 |
| Treatment C: | I | 526.2 | 1,977.4 | 365.0 | .4031 |
| | AC | 102.5 | 321.3 | 78.2 | .0608 |
| Treatment D: | I | 311.5 | 1,767.5 | 149.7 | .4044 |
| | AC | 72.1 | 419.9 | 33.8 | .0958 |
| Treatment E: | I | 781.2 | 3,054.2 | 528.6 | .6314 |
| | AC | 47.5 | 194.7 | 31.1 | .0409 |
| Treatment F: | I | 892.3 | 3,473.4 | 605.5 | .7170 |
| | AC | 62.8 | 241.4 | 43.0 | .0496 |
| Treatment G: | I | 973.3 | 3,825.4 | 656.4 | .7923 |
| | AC | 81.2 | 296.1 | 57.3 | .0597 |

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1/ Data provided by EPA. Supplement Table 32: Investment and annual costs by effluent reduction level for citrus products subcategory for typical small plant (400 TPD) and large plant (4,000 TPD).

2/ Indicates functional form where Y is either I or AC and X is tons per day (TPD) processed.

Table VI-6. Summary of investment (I) and annual cost (AC) data for selected apple products except juice plants. And estimated linear cost relationships for alternative treatment practices

| Treatment Practice and Type Cost | | Plant Data [1] | | Linear Cost Fcn:[2] Y=a+bX | |
|---|---|---|---|---|---|
| | | 100 TPD(S) | 1,000 TPD(L) | 'a' | 'b' |
| | | ($000) | ($000) | | |
| Treatment B: | I | 32.0 | 135.2 | 20.5 | .1147 |
| | AC | 11.8 | 34.4 | 9.3 | .2511 |
| Treatment C: | I | 74.0 | 278.2 | 51.3 | .2269 |
| | AC | 42.2 | 60.7 | 40.1 | .0206 |
| Treatment D: | I | 49.0 | 199.2 | 32.3 | .1669 |
| | AC | 11.0 | 45.3 | 7.2 | .0381 |
| Treatment E: | I | 242.0 | 600.2 | 202.2 | .3980 |
| | AC | 9.5 | 33.3 | 6.9 | .0264 |
| Treatment F: | I | 280.0 | 692.7 | 234.1 | .4586 |
| | AC | 17.4 | 48.8 | 14.1 | .0327 |
| Treatment G: | I | 295.0 | 757.7 | 243.6 | .5141 |
| | AC | 22.8 | 79.2 | 16.5 | .0627 |

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[1] Data provided by EPA. Supplement Table 31: Investment and annual costs by effluent reduction level for apple products except juice (only) subcategory for typical small plant (100 TPD) and large plant (1,000 TPD).

[2] Indicates functional form where Y is either I or AC and X is tons per day (TPD) processed.

Table VI-7. Summary of investment (I) and annual cost (AC) data for selected apple juice (only) plants. And estimated linear cost relationships for alternative treatment practices

| Treatment Practice and Type Cost | | Plant Data 1/ | | Linear Cost Fcn: 2/ Y=a+bX | |
|---|---|---|---|---|---|
| | | 100 TPD(S) | 500 TPD(L) | 'a' | 'b' |
| | | ($000) | ($000) | | |
| Treatment B: | I | 13.0 | 46.2 | 4.7 | .0830 |
| | AC | 4.3 | 14.0 | 1.9 | .0243 |
| Treatment C: | I | 23.0 | 80.2 | 8.7 | .1430 |
| | AC | 10.0 | 25.2 | 6.2 | .0380 |
| Treatment D: | I | 26.0 | 92.4 | 9.4 | .1660 |
| | AC | 5.1 | 22.1 | 0.85 | .0425 |
| Treatment E: | I | 152.0 | 272.2 | 122.0 | .3005 |
| | AC | 5.3 | 11.8 | 3.7 | .0163 |
| Treatment F: | I | 176.0 | 334.7 | 136.3 | .3968 |
| | AC | 11.1 | 22.1 | 8.4 | .0274 |
| Treatment G: | I | 182.0 | 356.7 | 138.3 | .4368 |
| | AC | 13.1 | 28.7 | 9.2 | .0389 |

1/ Data provided by EPA. Supplement Table 30: Investment and annual costs by effluent reduction level for apple juice (sale product) subcategory for typical small plant (100 TPD) and large plant (500 TPD).

2/ Indicates functional form where Y is either I or AC and X is tons per day (TPD) processed.

Table VI-8. Summary of industry wastewater treatment status based on sample data from the Ben Holt Co. (BH) and the National Canners Association (NCA)

| Type of Product | | Number of Plants | Percent of Plants by Type of Treatment | | | |
|---|---|---|---|---|---|---|
| | | | Municipal | Land (Irrig.) | Biological | None |
| Citrus | BH | 59 | 25 | 47 | 21 | 7 |
| | NCA | 6 | 30 | 42 | 5 | 23 |
| | Total[1] | 65 | 26 | 46 | 20 | 8 |
| Apple Products | BH | 41 | 33 | 38 | 14 | 15 |
| | NCA | 13 | 23 | 31 | 15 | 31 |
| | Total | 54 | 30 | 36 | 15 | 19 |
| Potatoes | BH | 41 | 10 | 44 | 36 | 10 |
| | NCA | 10 | 20 | 60 | 10 | 10 |
| | Total | 51 | 12 | 47 | 31 | 10 |
| Total | BH | 149 | 23 | 43 | 24 | 10 |
| | NCA | 29 | 24 | 43 | 11 | 22 |
| | Total | 170 | 23 | 43 | 22 | 12 |

[1] Percentage totals are weighted averages based on number of plants in the BH and NCA samples. Note samples are not necessarily mutually exclusive. NCA data summarized from information provided to DPRA.

Table VI-9. Estimated schedule of treatment strategies to be used by citrus and apple processors to meet the BPT and BAT effluent limitations guidelines [1]

| Description | BPT Treatment | | BAT Treatment | |
|---|---|---|---|---|
| | Strategy | Percent | Strategy | Percent |
| Citrus | | | | |
| Municipal | -- | 12 | -- | 12 |
| Secondary | B | 16 | C | 16 |
| | E | 16 | F | 10 |
| | | | G | 6 |
| Land | D | 56 | D | 56 |
| | | 100 | | 100 |
| Apple Products | | | | |
| Municipal | -- | 26 | -- | 26 |
| Secondary | B | 10 | C | 10 |
| | E | 10 | F | 6 |
| | | | G | 4 |
| Land | D | 54 | D | 54 |
| | | 100 | | 100 |

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[1] Schedule applies only to those plants which are not already on municipal systems or using land (irrigation) disposal methods.

Source: Derived from schedules provided by EPA.

Table VI-10. Estimated status of wastewater treatment in the citrus and apple processing industries plus projected distribution of treatment practices

| Type of Product and Time Period | Type of Treatment | | | | |
|---|---|---|---|---|---|
| | Municipal | Land Disposal[2] | Biological | None | Total |
| | (%) | (%) | (%) | (%) | (%) |
| Citrus | | | | | |
| 1973 (Current)[1] | 26 | 46 | 20 | 8 | 100 |
| 1977 (BPT) | 29 | 62 | B:4<br>E:5 | -- | 100 |
| 1983 (BAT) | 29 | 62 | C:4<br>F:3<br>G:2 | -- | 100 |
| Apples | | | | | |
| 1973 | 30 | 36 | 15 | 19 | 100 |
| 1977 | 39 | 54 | B:4<br>E:3 | -- | 100 |
| 1983 | 39 | 54 | C:4<br>F:2<br>G:1 | -- | 100 |

[1] Current status based on sample data presented in Table VI-8. Projection (rounded) based on estimated schedule presented in Table VI-9. Schedule applied to Biological and None categories only.

[2] Land disposal refers to spray irrigation strategy D as described.

## F. Relationships of Model Plants to Industry Categories

The citrus model plants in this analysis have been limited to orange juice products: frozen concentrated orange juice and canned single strength orange juice. Other citrus products are packed, e.g., grapefruit, tangerine, lemon, and blended citrus juices. Also, other product forms are packed, e.g., sections and salad. However, orange juice concentrate is by far the dominant frozen citrus product packed, and single strength orange juice is a major canned citrus product.

In the recent past, 1970-72, frozen concentrated orange juice represented over 90 percent of the frozen citrus pack as indicated in Table VI-11(excluding lemon juice and lemonade for which pack data are not reported). As also shown, canned single strength orange juice comprised about 39 percent of the canned citrus juice products.

Because of the dominance of frozen concentrated orange juice, the model plants used are assumed to effectively reflect this segment of the industry. Canned single strength orange juice plants represent a much smaller portion of the canned citrus products segment. However, based on data reported by A. H. Spurlock (Costs of Processing, Warehousing and Selling Florida Citrus Products, 1971-72 Season, Econ. Report 46, U. of Florida, April 1973), the average costs per case for processing orange juice, grapefruit juice and blended juice are quite similar, and the processing characteristics are comparable. Thus, the canned single strength orange juice model plants are regarded as surrogates for citrus product canning operations.

Canned grapefruit sections, canned citrus salad, and chilled citrus juices and salad are not represented by the model plants, but these products are relatively minor compared with the main processed products as described. Plant data regarding these products is also meager.

Regarding processed apple products, canning operations are dominant. As shown in Table VI-12, about 61 percent of the canned apples are packed as apple sauce, about 33 percent of the cases packed are apple juice, and only 6 percent are sliced or whole canned apples. By comparison, frozen apples and sauce represent only about 5 to 6 percent of the total canned volume packed.

Table VI-11. Selected pack statistics for processed citrus products, 1970-72

| | Annual Pack | | | |
|---|---|---|---|---|
| Type of Pack | 1970 | 1971 | 1972 | Average Percent 1/ |
| | ------ Thousands of Gallons ------ | | | |
| Frozen Concentrated Citrus Juices | | | | |
| Orange | 126,402 | 125,187 | 134,229 | 93.3% |
| Grapefruit | 4,294 | 6,870 | 8,798 | 4.8% |
| Grapefruit-Orange | 16 | 18 | 22 | .1% |
| Lemon | N.A. | N.A. | N.A. | N.A. |
| Lemonade | N.A. | N.A. | N.A. | N.A. |
| Limeade | 1,345 | 1,648 | 1,498 | 1.1% |
| Tangerine | 785 | 1,090 | 1,220 | .8% |
| | | | | 100.0% |
| Canned Citrus Juices | -- Thousands of Actual Cases | | | |
| Grapefruit | 23,854 | 24,891 | N.A. | 57.1 |
| Orange | 16,966 | 15,927 | N.A. | 38.6 |
| Blended Citrus | 2,046 | 1,626 | N.A. | 4.3 |
| Tangerine | N.A. | N.A. | N.A. | N.A. |
| | | | | 100% |
| Other Citrus Products | | | | |
| Grapefruit Sections | 3,841 | 3,113 | N.A. | |

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1/ Calculated for years shown and for pack data reported only.

Source: The Almanac of the Canning, Freezing, Preserving Industries, 1973, Edward E. Judge & Sons, Inc., Westminister, Md., 1972

Table VI-12. Selected pack statistics for apple products, 1970-72

| Type of Pack | 1970 | 1971 | 1972 | Average Percent [1] |
|---|---|---|---|---|
| Canned Apple Products -- Thousand of Actual Cases -- | | | | |
| Apples | 2,271 | 2,564 | N.A. | 5.7% |
| Apple Sauce | 24,291 | 26,399 | N.A. | 60.3% |
| Apple Juice | 14,472 | 14,148 | N.A. | 34.0% |
| Frozen Apple Products -- Thousands of Pounds | | | | |
| Apples and Sauce | 100,370 | 96,999 | 130,377 | |
| Est. Case Equiv. | (2,478) | (2,395) | (3,219) | |

[1] Calculated for pack data as reported.

Source: The Almanac of the Canning, Freezing, Preserving Industries, 1973, Edward E. Judge & Sons, Inc., Westminister, Md., 1972.

The model plants involving canned apple products reflect the major processing operations of concern in this study. An advantage of the single product models is that individual product line effluent characteristics can be assessed. However, a more general problem is the evaluation of multiproduct plants (apples only or apples plus other products) which are inadequately represented by the single product model plants used herein.

The single product canned apple products model plants of this study are taken as a first approximation of the expected impacts on various segments of the apple processing industry. In the case of multiple apple products, some judgment can be made of composite impacts by weighting the individual product line impacts. Consideration of additional products would essentially require a plant by plant analysis within the industry. Such an approach was beyond the scope of this study.

# VII. IMPACT ANALYSIS [1]

The impacts of direct discharge effluent guidelines on the citrus and apple products processing industries are expected to be moderate on an industry-wide basis but with selected segments of these industries likely to be impacted severely. For example, single strength orange juice plants will be impacted seriously regardless of size, and small plants in the apple slices and apple sauce segments of the industry are likely to shutdown.

A mitigating influence on the processing industries studied is that approximately two-thirds of the plants either are tied into municipal treatment systems or currently have in place land disposal (spray irrigation) systems. The former plants are not directly subject to the guidelines of this study. The latter plants employ a treatment strategy that is generally acceptable to meet both the proposed BPT (Best Practicable Control Technology) and BAT (Best Available Technology Economically Achieveable) guidelines. Consequently, only about one-third of the industries studied will be required to upgrade and/or install waste treatment systems.

Process wastes from the fruits and vegetable processing industries are generally well suited for biological treatment in municipal waste treatment systems. Thus, pretreatment effluent limitation guidelines and associated pretreatment control practices were not specified for this study. Also, the new source performance standards (NSPS) were set equal to the BAT guidelines for 1983. Therefore, NSPS impacts are considered comparable to those shown for the BAT level of control.

In this section, impacts of the BPT and the BAT proposed standards and associated abatement strategies are discussed. Estimated impacts are based primarily on expected financial effects of the pollution control costs (as provided) on representative model plants in the industry.

The impacts considered in this analysis include the following:

- Price effects
- Financial effects
- Production effects
- Employment effects
- Community effects
- Other effects, e.g., balance of payments

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[1] A preliminary impact analysis of water pollution controls on the potato processing industry is reported in Appendix A.

## A. Price Effects

A series of model plants for specific segments of both the citrus and apple products processing industries were simulated and evaluated with and without pollution controls. One analysis was to estimate the percentage price increase that would be required to recover the estimated cost of pollution control. A total of 15 model plant situations were assessed. A brief summary of the estimated price increases required to recover costs are indicated immediately below. A more detailed summary which also illustrates the treatment strategies involved is as shown in Table VII-1.

| Plant and Size Class | Percent Change in Price Needed[1/]<br>BPT<br>(%) | <br>BAT<br>(%) |
|---|---|---|
| **Citrus - Frozen Concentrate O.J.** | | |
| Small | 1.9 - 2.5 | 2.1 - 4.1 |
| Medium | .7 - 1.0 | 1.1 - 1.5 |
| Large | .4 - .7 | .8 - .9 |
| **Citrus - Single Strength O. J.** | | |
| Small | 4.4 - 5.5 | 4.4 - 9.5 |
| Medium | 2.3 - 3.0 | 2.5 - 4.9 |
| Large | 1.1 - 1.4 | 1.3 - 2.2 |
| **Apples - Canned Slices** | | |
| Small | 1.0 - 1.8 | 1.0 - 4.3 |
| Medium | .6 - 1.3 | .6 - 2.3 |
| Large | .5 - 1.1 | .5 - 1.5 |
| **Apples - Canned Sauce** | | |
| Small | .8 - 1.5 | .8 - 3.6 |
| Medium | .5 - 1.1 | .5 - 1.9 |
| Large | .4 - .9 | .4 - 1.3 |
| **Apples - Canned Juice** | | |
| Small | .6 - 1.7 | .6 - 2.8 |
| Medium | .4 - .9 | .5 - 1.6 |
| Large | .3 - .7 | .5 - 1.2 |

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[1/] Price change such that net income of the plant remains constant. Ranges reflect alternative treatment strategies.

Table VII-1. Percent increase in prices required after pollution controls to maintain net income for selected model plants.

| | Size | | Treatment Alternative | | | | |
|---|---|---|---|---|---|---|---|
| | | | BPT | | BAT | | Both |
| Type of Plant | Class | Tons/Day | B | E | C | F | D |
| **Citrus** | | | | | | | |
| Frozen Concentrate, Orange Juice | S | 144 | 1.9 | 2.5 | 4.1 | 3.2 | 2.1 |
| | M | 528 | .7 | 1.0 | 1.5 | 1.3 | 1.1 |
| | L | 1,072 | .4 | .7 | .9 | .8 | .8 |
| Single Strength Orange Juice | S | 54 | 4.4 | 5.5 | 9.5 | 7.2 | 4.4 |
| | M | 109 | 2.3 | 3.0 | 4.9 | 3.9 | 2.5 |
| | L | 272 | 1.1 | 1.4 | 2.2 | 1.8 | 1.3 |
| **Apple** | | | | | | | |
| Canned Apple Slices | S | 32 | 1.8 | 1.8 | 4.3 | 2.6 | 1.0 |
| | M | 64 | 1.3 | 1.0 | 2.3 | 1.5 | .6 |
| | L | 96 | 1.1 | .7 | 1.5 | 1.0 | .5 |
| Canned Apple Sauce | S | 32 | 1.5 | 1.5 | 3.6 | 2.2 | .8 |
| | M | 64 | 1.1 | .8 | 1.9 | 1.2 | .5 |
| | L | 96 | .9 | .6 | 1.3 | .8 | .4 |
| Canned Apple Juice | S | 48 | .6 | 1.7 | 1.4 | 2.8 | .6 |
| | M | 96 | .4 | .9 | .9 | 1.6 | .5 |
| | L | 144 | .3 | .7 | .7 | 1.2 | .5 |

The indicated price effects would be applicable at the plant level assuming each such plant could pass-through price increases. However, each plant is not expected to independently change prices. First, larger plants with generally lower per unit cost increases would tend to establish new price levels and smaller firms would then recover only part of their increased costs. Second, and probably the dominant factor in these industries, the two-thirds of the plants either on municipal systems or those with land disposal systems should be largely unaffected by the guidelines. Also, the price structures of these industries are highly competitive. As a consequence, average industry prices are expected to change only slightly as a direct result of the controls.

Industry prices may also be affected due to supply shifts resulting from production curtailments and/or plant shutdowns. In general, there has been underutilization of capacity in these industries except for peak periods. Thus, production losses from plant shutdowns (described below) should be picked-up by the remaining segments of the industry; and, substantive supply shifts would not be expected.

Based on the above considerations, price increases on an industry-wide basis should be limited at most to the levels determined by the largest producers. Thus, BPT controls are generally expected to result in price increases of less than 1 percent, and the BAT controls are expected to result in less than 2 percent price increases.

More precise estimates of industry-wide price changes may be established given relative weights for each type of plant, e.g., number and size distribution of plants and relative volumes of each type of product packed.

A summary of available plant information is presented in Table VII-10. below for the citrus and apple processing industries. Also, based on 1968-70 average production data, the following percentages of raw products were processed:

| Type of Product | Relative Raw Product Packed |
|---|---|
| Citrus - Orange Juice | |
| Frozen Concentrate O.J. | 85% |
| Single Strength O.J. | 15% |
| | 100% |
| Apples - Canned | |
| Slices | 12% |
| Sauce | 47% |
| Juice | 41% |
| | 100% |

Applying the percentages above as weights to large model plants only, then average citrus (orange juice) prices for large plants would need to increase from .5 to .8 percent to cover BPT control costs, and from .9 to 1.1 to cover BAT costs as provided. Similarly, large apple processing plants would require weighted average increases in prices from .4 to .9 percent for BPT control and from .5 to 1.3 percent for BAT control. Other weighted averages might be calculated for medium and small plants to determine relative impacts for multiproduct types of plants and industry averages.

Another general concern regarding price (and other) effects of the proposed controls is the accuracy of the pollution abatement costs. To assess the sensitivity of price changes to pollution control costs, the estimated control costs were increased by 50 percent. (Industry representatives expressed that such levels of increase or more were likely for some treatment strategies.) The incremental price increases required to maintain net incomes are shown in Table VII-2 for selected model plants. For example, price increases needed for BAT control in large plants would range from about .3 to .6 percent more among the model cases shown.

## B. Financial Effects

Two primary types of analysis were completed to assess the financial impacts of the proposed pollution control costs on the model plants: (1) profitability impacts, and (2) impacts on the present value of future net income streams.

Profitability. The profitability of all plants which are required to add pollution control facilities will be adversely affected. This is indicated in Tables VII-3 and VII-4 for all model plants (assuming no price increases). Net incomes are shown to decrease in direct relation to the pollution control investment and annual operating costs. Also reported are estimates of net income as a percent of sales and the after tax return on investment (ROI) for each model plant under alternative treatment conditions.

Table VII-2. Incremental price increases required by selected model plants[1] to maintain net income with a 50 percent increase in estimated pollution control costs

| | | Treatment Alternative | | | | |
|---|---|---|---|---|---|---|
| | | BPT | | BAT | | Both |
| Type of Plant | Size | B | E | C | F | D |
| Citrus | | | | | | |
| Frozen O.J. Concentrate | S | 1.0 | 1.3 | 2.1 | 1.4 | 1.1 |
| | M | .4 | .5 | .8 | .6 | .5 |
| | L | .2 | .3 | .5 | .4 | .4 |
| Apple | | | | | | |
| Canned apple slices | M | .6 | .5 | 1.1 | .7 | .3 |
| | L | .6 | .4 | .9 | .6 | .3 |
| Canned apple sauce | M | .5 | .4 | 1.3 | .6 | .5 |
| | L | .5 | .3 | .6 | .5 | .2 |
| Canned apple juice | S | .5 | .8 | .8 | 1.5 | .5 |
| | M | .2 | .7 | .4 | .8 | .3 |
| | L | .2 | .4 | .3 | .5 | .2 |

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[1] Plants selected were only those with positive NPV's after original pollution control costs were applied.

Table VII-3. Net profits and return on investment for selected citrus processing plants with and without pollution control costs.

| Type of Plant and Treatment Strategy | Small Plants | | | Medium Plants | | | Large Plants | | |
|---|---|---|---|---|---|---|---|---|---|
| | Net Income ($000) | Net Inc. % Sales (%) | After Tax ROI (%) | Net Income ($000) | Net Inc. % Sales (%) | After Tax ROI (%) | Net Income ($000) | Net Inc. % Sales (%) | After Tax ROI (%) |
| Frozen Concentrate O.J. | | | | | | | | | |
| Base Line | 125 | 4.6 | 11.2 | 420 | 4.4 | 10.6 | 948 | 4.7 | 12.4 |
| BPT: B | 97 | 3.6 | 8.0 | 386 | 4.1 | 9.4 | 903 | 4.4 | 11.2 |
| E | 89 | 3.3 | 6.3 | 370 | 3.9 | 8.4 | 879 | 4.3 | 10.7 |
| BAT: C | 66 | 2.4 | 5.0 | 346 | 3.7 | 8.1 | 847 | 4.2 | 10.6 |
| F | 79 | 2.9 | 5.4 | 358 | 3.8 | 8.0 | 862 | 4.2 | 10.4 |
| D | 94 | 3.5 | 7.7 | 367 | 3.9 | 8.9 | 863 | 4.3 | 10.9 |
| Single Strength O.J. | | | | | | | | | |
| Base Line | 13 | .9 | 8.6 | 16 | .5 | 1.3 | 59 | .7 | 1.7 |
| BPT: B | (36) | <0 | <0 | (35) | <0 | <0 | (1) | <0 | <0 |
| E | (48) | <0 | <0 | (50) | <0 | <0 | (18) | <0 | <0 |
| BAT: C | (92) | <0 | <0 | (93) | <0 | <0 | (64) | <0 | <0 |
| F | (66) | <0 | <0 | (70) | <0 | <0 | (40) | <0 | <0 |
| D | (35) | <0 | <0 | (38) | <0 | <0 | (14) | <0 | <0 |

Table VII-4. Net profits and return on investment for selected apple processing plants with and without pollution control costs.

| | Small Plants | | | Medium Plants | | | Large Plants | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of Plant and Treatment Strategy | Net Income ($000) | Net Inc. % Sales (%) | After Tax ROI (%) | Net Income ($000) | Net Inc. % Sales (%) | After Tax ROI (%) | Net Income ($000) | Net Inc. % Sales (%) | After Tax ROI (%) |
| Canned Apple Slices | | | | | | | | | |
| Base Line | 7 | .7 | 1.2 | 90 | 4.4 | 8.1 | 144 | 4.7 | 9.0 |
| BPT: B | (10) | < 0 | < 0 | 77 | 3.8 | 6.8 | 126 | 4.1 | 7.8 |
| E | (8) | < 0 | < 0 | 79 | 3.9 | 6.4 | 133 | 4.3 | 7.7 |
| BAT: C | (34) | < 0 | < 0 | 67 | 3.3 | 5.8 | 118 | 3.9 | 7.3 |
| F | (17) | < 0 | < 0 | 75 | 3.7 | 6.0 | 128 | 4.2 | 7.3 |
| D | 0 | < 0 | < 0 | 85 | 4.2 | 7.5 | 136 | 4.4 | 8.3 |
| Canned Apple Sauce | | | | | | | | | |
| Base Line | 4 | .3 | .7 | 90 | 3.7 | 9.8 | 138 | 3.8 | 9.2 |
| BPT: B | (12) | < 0 | < 0 | 77 | 3.1 | 8.3 | 120 | 3.3 | 7.9 |
| E | (12) | < 0 | < 0 | 80 | 3.3 | 7.8 | 127 | 3.5 | 7.9 |
| BAT: C | (38) | < 0 | < 0 | 67 | 2.7 | 7.1 | 114 | 3.1 | 7.4 |
| F | (21) | < 0 | < 0 | 75 | 3.1 | 7.2 | 122 | 3.3 | 9.1 |
| D | (4) | < 0 | < 0 | 85 | 3.5 | 7.5 | 131 | 3.6 | 8.6 |
| Canned Apple Juice | | | | | | | | | |
| Base Line | 21 | 3.3 | 7.6 | 107 | 8.4 | 21.1 | 175 | 9.1 | 24.0 |
| BPT: B | 19 | 3.0 | 6.8 | 105 | 8.3 | 20.4 | 172 | 9.0 | 23.5 |
| E | 14 | 2.2 | 4.1 | 101 | 8.0 | 17.4 | 168 | 8.8 | 20.8 |
| BAT: C | 16 | 2.5 | 5.8 | 102 | 8.0 | 19.7 | 168 | 8.8 | 22.7 |
| F | 9 | 1.4 | 2.6 | 97 | 7.6 | 16.3 | 164 | 8.6 | 20.0 |
| D | 19 | 3.0 | 6.7 | 104 | 8.2 | 20.0 | 170 | 8.9 | 22.9 |

As shown in the tables, all single strength orange juice model plants (small, medium and large) are shown to have negative net incomes after pollution control costs are added. Such plants, plus at least small plants with this product line, are expected to be impacted severely. As discussed further below, such plants are expected to close. Further, small processors of apple slices and apple sauce are projected to be severely impacted.

Net profits and rates of return on investment for the model plants are as presented in Tables VII-3 and VII-4 for the pollution control cost levels as provided. Comparative estimates are shown in Tables VII-5 and VII-6 for 50 percent increases in pollution control costs for selected plants. After-tax net incomes are typically not reduced dramatically relative to the original level control costs, primarily because pollution control costs are tax deductible. Therefore, the incremental burden is effectively less than implied by the 50 percent increase, e.g., about half or 25 percent for most plants.

Net Present Value (NPV). Another measure of the financial viability of a plant is the net present value (NPV) of projected streams of costs and revenues. With this measure it is possible to assess the likelihood of continued plant operation versus closure. By discounting at the cost of capital rate (see Chapter V), then positive NPV's would indicate the likelihood of continued plant operation; whereas negative values indicate probable plant shutdowns. To complete this analysis, the following assumptions were made:

1. Existing plants have sunk investments but they presumably could be scrapped or salvaged and the salvage value reinvested elsewhere as an alternative to the processing operation. However, only 10 percent of the estimated replacement cost of a citrus or apple processing plant is assumed recoverable. This relatively low value is based on little opportunity for use of equipment outside the industry and low prospects for use as replacement equipment in existing plants. Also, buildings are typically older buildings and not well suited for other uses.

2. Revenues and expenses are assumed to remain constant over time, i.e., 20 years of operation.

3. The estimated cost of capital for the industry is 6.0 percent after taxes (see Page V-8).

Table VII-5. Net profits and return on investment for selected citrus processing plants with a 50 percent increase in pollution control costs

| | Small Plants | | | Medium Plants | | | Large Plants | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of Plant and Treatment Strategy | Net Income ($000) | Net Inc. % Sales (%) | After Tax ROI (%) | Net Income ($000) | Net Inc. % Sales (%) | After Tax ROI (%) | Net Income ($000) | Net Inc. % Sales (%) | After Tax ROI (%) |
| Frozen Concentrate O.J. | | | | | | | | | |
| BPT: B | 84 | 3.1 | 6.6 | 368 | 3.9 | 8.8 | 881 | 4.3 | 11.1 |
| E | 71 | 2.6 | 4.5 | 345 | 3.6 | 7.4 | 843 | 4.2 | 10.0 |
| BAT: C | 37 | 1.4 | 2.6 | 308 | 3.3 | 7.0 | 800 | 3.9 | 9.7 |
| F | 57 | 2.1 | 3.5 | 326 | 3.4 | 7.0 | 818 | 4.0 | 9.5 |
| D | 79 | 2.9 | 6.2 | 341 | 3.6 | 8.1 | 820 | 4.0 | 10.2 |

Table VII-6. Net profits and ROI for selected apple processing plants with a 50 percent increase in pollution control costs

| Type of Plant and Treatment Strategy | | Small Plants<br>Net Income ($000) | Small Plants<br>Net Inc. % Sales (%) | Small Plants<br>After Tax ROI (%) | Medium Plants<br>Net Income ($000) | Medium Plants<br>Net Inc. % Sales (%) | Medium Plants<br>After Tax ROI (%) | Large Plants<br>Net Income ($000) | Large Plants<br>Net Inc. % Sales (%) | Large Plants<br>After Tax ROI (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Canned Apple Slices | | | | | | | | | | |
| BPT: | B | | 1/ | | 70 | 3.4 | 6.2 | 117 | 3.8 | 7.2 |
| | E | | | | 75 | 3.7 | 5.8 | 127 | 4.1 | 7.1 |
| BAT: | C | | | | 55 | 2.7 | 4.7 | 106 | 3.5 | 6.4 |
| | F | | | | 67 | 3.3 | 5.2 | 119 | 3.9 | 6.6 |
| | D | | | | 81 | 4.0 | 7.0 | 132 | 4.3 | 8.0 |
| Canned Apple Sauce | | | | | | | | | | |
| BPT: | B | | 1/ | | 70 | 2.9 | 7.5 | 111 | 3.0 | 7.3 |
| | E | | | | 75 | 3.1 | 6.9 | 121 | 3.3 | 7.3 |
| BAT: | C | | | | 55 | 2.2 | 5.7 | 102 | 2.8 | 6.6 |
| | F | | | | 67 | 2.7 | 6.0 | 115 | 3.1 | 6.8 |
| | D | | | | 81 | 3.3 | 8.5 | 127 | 3.5 | 8.3 |
| Canned Apple Juice | | | | | | | | | | |
| BPT: | B | 17 | 2.7 | 6.1 | 103 | 8.1 | 20.0 | 170 | 8.9 | 23.1 |
| | E | 10 | 1.6 | 2.7 | 97 | 7.6 | 15.6 | 164 | 8.6 | 19.3 |
| BAT: | C | 12 | 1.9 | 4.2 | 99 | 7.8 | 18.9 | 165 | 8.7 | 22.1 |
| | F | 2 | .3 | .5 | 91 | 7.2 | 14.4 | 158 | 8.3 | 18.2 |
| | D | 17 | 2.7 | 5.9 | 102 | 8.0 | 19.4 | 168 | 8.8 | 22.4 |

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1/ Plants omitted since closure is assumed to have occurred at original level, therefore there is no need to consider at 50 percent increase level.

The net present values were calculated for model plants both with and without pollution controls. These results are shown in Table VII-7.

As indicated, all model plants without pollution controls had positive net present values which indicates that they would--without controls--likely continue to operate versus disposing of facilities and reinvesting elsewhere. However, with pollution controls, specific types and sizes of plants are likely to shutdown. The treatment strategy or alternative involved is also a factor.

The most severely impacted type of plant is single strength orange juice where small, medium and large plants would likely shut down given either the B-C or the E-F treatment strategies. Also, only the large plant would likely continue under the D strategy (land spray irrigation).

In the apple processing industry, the small canned apple juice and the small canned apple sauce plants would be expected to shutdown--regardless of treatment strategy as depicted. All remaining types of plants would be expected to continue operations under the assumptions indicated.

A sensitivity analysis of NPV's was completed for selected model plants assuming a 50 percent increase in pollution control costs. The results are reported in Table VII-8 for those model plants which had positive NPV's with the original pollution control costs. Only one additional type of plant (small canned apple juice) under the high cost E-F treatment strategy was shown to likely shut down. Thus, for up to 50 percent higher costs, very few additional closures are expected.

Another special analysis was made to determine if any of the plants which were projected to close would remain open to 1983 only. That is, would a plant possibly meet the BPT guidelines in 1977 but close in 1983 rather than meet the BAT guidelines. In this case, only the large single strength orange juice plant would likely do so. The most probable treatment strategy would be alternative B.

Table VII-7. Net present values of selected citrus and apple processing model plant cash flows with and without pollution controls

| | Net Present Value | | | Treatment Strategy | | |
|---|---|---|---|---|---|---|
| | Size | | W/O | BPT BAT | BPT BAT | Land |
| | Class | Tons/Day | PC | B----C | E----F | D |
| | | | ($1000) | | | |
| **Citrus** | | | | | | |
| Orange Juice, Frozen Concentrate | S | 144 | 1,507 | 816 | 735 | 1,059 |
| | M | 528 | 5,880 | 5,003 | 4,818 | 5,116 |
| | L | 1,072 | 13,278 | 12,100 | 11,801 | 12,053 |
| Orange Juice, Single Strength | S | 54 | 159 | (905)[1/] | (903) | (426) |
| | M | 109 | 285 | (813) | (845) | (368) |
| | L | 272 | 964 | (68) | (138) | 280 |
| **Apples** | | | | | | |
| Canned Apple Slices | S | 32 | 90 | (294) | (259) | (5) |
| | M | 64 | 1,226 | 982 | 964 | 1,148 |
| | L | 96 | 1,947 | 1,679 | 1,675 | 1,840 |
| Canned Apple Sauce | S | 32 | 61 | (334) | (299) | (45) |
| | M | 64 | 1,350 | 1,106 | 1,093 | 1,272 |
| | L | 96 | 1,961 | 1,686 | 1,682 | 1,854 |
| Canned Apple Juice | S | 48 | 252 | 206 | 73 | 224 |
| | M | 96 | 1,369 | 1,316 | 1,199 | 1,321 |
| | L | 144 | 2,230 | 2,159 | 2,041 | 2,163 |

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[1/] Parentheses denote negative NPV's and, thus, probable plant closures.

Table VII-8. Net present values of selected model plant cash flows with a 50 percent increase in pollution control costs

| | Size | Treatment Strategy ( With + 50% Costs) BPT BAT B ----C | BPT BAT E ---- F | Land D |
|---|---|---|---|---|
| | | ------------------($1000) | | ------------------ |
| Citrus | | | | |
| Orange Juice, Frozen Concentrate | S | 484 | 210 | 839 |
| | M | 4,654 | 4,284 | 4,740 |
| | L | 11,514 | 11,051 | 11,439 |
| Apples | | | | |
| Canned Slices | M | 855 | 833 | 1,092 |
| | L | 1,548 | 1,536 | 1,753 |
| Canned Sauce | M | 979 | 957 | 1,216 |
| | L | 1,562 | 1,550 | 1,807 |
| Canned Juice | S | 172 | (26) [1/] | 203 |
| | M | 1,273 | 1,112 | 1,298 |
| | L | 2,129 | 1,942 | 2,136 |

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[1/] Parentheses denote negative NPV's and, thus, probable plant closure.

## C. Production Effects

The citrus and apple processing industries have generally experienced slight to moderate rates of growth during the past decade in terms of physical volumes packed. An exception has been canned apple slices (and whole apples), which have declined in volume packed. A summary of recent pack data for the principal products in this analysis is shown in Table VII-9. More detailed data are presented in Chapter II.

A summary of available plant data regarding both the citrus and apple processing industries is presented in Table VII-10. In 1972, 105 plants were involved with citrus products processing, although only 41 were strictly citrus processors. The remaining 64 plants also processed other fruit and/or vegetable products. Plants involved with citrus processing are typically multiproduct plants rather than single-product plants. (Further descriptions of citrus processors are reported in Tables II-19 and II-20.)

Also in 1972, 144 plants processed canned or frozen apple products. Twenty-nine (29) plants packed only apple products, while the remainder were about equally distributed as fruit only and as fruit and vegetable processors. The most prevalent apple products only plants were plants processing cider and juice (8), slices only (4), cider only (4), and sauce, cider and juice (4). The majority produced multiple products, however. (See Tables II-25 and II-26.)

Also shown in Table VII-10 are estimated distributions of citrus and apple processing plants by size category, and the estimated volume of pack by each size category of plants. It is noted that small plants comprise a relatively small portion of total industry pack. Consequently, small plant closures do not commonly affect industry-wide patterns substantially and/or production losses can be made-up by larger plants. Local economic impacts can be severe, however. These factors are discussed further below.

Table VII-9. Summary of recent pack data for selected citrus and apple products

| Type of Product | Units | Annual Pack 1968 | 1969 | 1970 | 1971 |
|---|---|---|---|---|---|
| Citrus | | | | | |
| Frozen Concentrate, Orange Juice | 1,000 gal. | 83,697 | 108,043 | 126,402 | 125,187 |
| Canned Orange Juice | 1,000 cases | 15,691 | 17,082 | 16,966 | N.A. |
| Apples | | | | | |
| Apple Slices (& Whole) | 1,000 cases | 3,604 | 3,128 | 2,271 | N.A. |
| Apple Sauce | 1,000 cases | 24,073 | 27,533 | 23,647 | N.A. |
| Apple Juice | 1,000 cases | 9,641 | 13,503 | 14,472 | N.A. |

Source: The Almanac of the Canning, Freezing, Preserving Industries, 1972, Edward E. Judge & Son, Inc., Westminster, Md., 1972.

Table VII-10. Summary of estimated plant numbers and volumes packed by size category for the citrus and apple processing industries

| Type Plant | Size Category [1] | | | |
|---|---|---|---|---|
| | Small | Medium | Large | Total |
| Citrus | | | | |
| Citrus Only | -- | -- | -- | 41 |
| Citrus plus other | -- | -- | -- | 64 |
| Total citrus | 36 | 43 | 26 | 105 |
| Approx. Volume Packed [1] | 10% | 30% | 60% | 100% |
| Apples | | | | |
| Apples only | -- | -- | -- | 29 |
| Apples plus other | -- | -- | -- | 115 |
| Total apples | 63 | 42 | 39 | 144 |
| Approx. Volume Packed | 5% | 40% | 55% | 100% |

---

[1] Size categories here are defined to include total pack of all products processed. Therefore, these sizes are larger than the single-product model plant categories as defined. Based on Judge, the size ranges for these plants are as follows:

Small ≤ 500,000 canned cases or 10 million frozen pounds

Medium = 500,000 to 5 million canned cases or 10-100 million frozen pounds

Large ≤ 5 million canned cases or 100 million frozen pounds

Source: The Directory of the Canning, Freezing, Preserving Industries, 1972-73, Edward E. Judge & Son, Inc., Westminster, Md., 1972.

## Baseline Closures

There has been a general decline in the number of fruit and vegetable canning and freezing plants throughout the U.S. in recent years. For example, Census of Manufacturers data for the most recent census years indicates the following numbers of fruit and vegetable canning and freezing plants:

| Year | Canners | Freezers |
|---|---|---|
| 1958 | 1,630 | 303 |
| 1963 | 1,422 | 650 |
| 1967 | 1,223 | 608 |

The overall rate of decline in canning plants from 1958 to 1967 was about 2.8 percent per year. For freezers, the decline from 1963 to 1967 was about 1.6 percent per year.

More recent data compiled from The Directory of the Canning, Freezing and Preserving Industries, by Edward E. Judge, for 1970-71 and 1972-73 indicates that the overall rate of decline for both canners and freezers may have decreased in the 1970-72 period. From this source it was estimated that 183 plants closed from 1970-72; but, also, 151 new fruit and vegetable canning and freezing plants were opened (or newly listed). Thus, a net loss of only 32 plants was recorded between 1970 and 1972. This represented only a 1.3 percent net decline per year for both canners and freezers. Some plants may have existed prior to 1970 but were first reported in The Directory in 1972. This would result in actual net losses greater than the 1.3 percent per year.

As suggested, conclusive baseline plant closure data are not readily available. In our judgment, net plant closures are estimated to be between 2.8 and 1.3 percent per year for both fruit and vegetable canners and freezers, e.g., 2 percent per year. It is also noted that the productive capacity of this composite industry has probably increased despite net losses in plant numbers. New plants are typically larger than old plants which have closed across all product classes.

Using the 2 percent estimate as a basis for projecting baseline plant closures in this analysis (prior to enforcement of pollution controls), then the following summary of annual closures is projected:

| Type of Processor | Present No. of Plants | Baseline Annual Closures [1] | |
|---|---|---|---|
| Citrus | | | |
| Citrus only | 41 | 1 | (0.82) |
| Citrus plus other | 64 | 1 | (1.28) |
| Total | 105 | 2 | (2.10) |
| Apples | | | |
| Apples only | 29 | 1 | (0.58) |
| Apples plus other | 115 | 2 | (2.30) |
| Total | 144 | 3 | (2.88) |

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[1] Closure estimates would decrease slightly overtime as "present" numbers of plants decline.

Again, these estimates are projected annual net losses. Also, while plant closures may occur among all size segments of plants, the greatest losses are expected to occur among the small size categories.

The above annual projections of plant closures can be extended to yield the following baseline estimates for 1977 and 1983 as follows:

| Type of Processor | Total Baseline Plant Closures 1973-77 | 1977-83 | 1973-83 |
|---|---|---|---|
| Citrus | 8 | 10 | 18 |
| Apples | 12 | 13 | 25 |
| Total | 20 | 23 | 43 |

## Plant Shutdowns Resulting From Pollution Control Guidelines

Based upon the above financial analyses, three basic groups of model plants are highly subject to shutdown due to the increased burden of pollution control costs (and little offsetting price increases):

1. Single Strength Orange Juice plants (Small, Medium and Large)
2. Small Apple Slices plants
3. Small Apple Sauces plants.

All other model plants remained "viable" with added pollution control costs -- including treatment strategies B to C, E to F and D as described. (Note E to G was similar to the E to F alternative and not repeated. The impacts would be from 5 to 10 percent greater and conclusions would be generally the same as for the E to F alternative.) Furthermore, based on sensitivity analysis using increased pollution control costs of +50 percent, the expected shutdowns were basically the same (small canned apple juice plants would also likely shutdown under the E to F control alternative; otherwise the same results apply).

Also, it is noted that the plants would in general close in 1977 (BPT level) rather than continue to 1983. Consequently, plant shutdowns due to pollution controls -- and above the baseline case, are both limited in scope and expected during the initial enforcement period (1977).

Citrus Plant Closures Above Baseline. A review of Judge's The Directory for 1972-73 indicates only 5 single strength canned citrus juice processors which only produce canned juice in the small, medium and large categories as depicted by the model plants. One other plant was a very large operation and it was assumed that it probably had adequate economies of scale to continue. In other words, 5 plants are expected to shutdown by 1977 if treatment facilities must be installed. However, some other prior assumptions lead to the following implications:

- 1 plant closure attributed to baseline conditions;
- 2 plants probably already on municipal or land disposal systems;
- 2 remaining plants shutdown due to pollution controls.

Another group of plants (6) were estimated to be single product frozen concentrate citrus processors. However, these plants are not expected to shutdown based on model plant results. Further, the remaining citrus plants are multiproduct plants -- both citrus only and citrus plus other products. While model plants did not specifically cover these plants, it is concluded that any combination of products is relatively better than the single strength juice model case. Except for baseline closures, no additional plant shutdowns can be conclusively projected at this time.

In conclusion, two basic types of shutdown impacts on the citrus industry are expected:

1. All 18 projected baseline citrus plant closures from 1973 to 1983 are expected to occur by 1977 (subsequent to BPT guidelines). This includes 10 plants which were projected to operate beyond 1977. Most of the baseline plant closures are expected to involve relatively small operations.

2. Single strength citrus juice plants are expected to be impacted most severely. Only 5 applicable operations were identified. Based on assumed treatment systems in place and baseline conditions, a net closure of only 2 plants is projected due to pollution controls.

Apple Processing Plant Closures Above Baseline. As noted above, only small apple slices and sauce processing plants are expected to be severely impacted due to BPT and BAT controls. Based again on data from The Directory only about 14 plants fall into the small category as defined by the model plants of this study. This includes small plants which produce slices, sauce, both, and limited other products where the total operation remains small.

Again not all 14 plants will necessarily close due to controls, and the following breakdown is projected:

- 2 plant closures due to baseline conditions,
- 8 plants probably already on municipal or land disposal systems,
- 4 remaining plants shutdown due to pollution controls.

As shown in Table VII-10 there are a total of 63 small apple processing plants. However, beyond the above shutdowns and expected baseline closures (25 primarily small) the model plant results do not conclusively indicate that other forced shutdowns are expected. Additional multiproduct model plant cases would be desired, but virtually all plants produce unique combinations of pack.

As stated similarly for citrus, there are two basic types of shutdown impacts which are expected in the apple processing industry:

1. Baseline closures will occur more rapidly. In this case, all 25 projected 1973-83 baseline closures are expected by 1977 following BPT guidelines enforcement. This includes 13 plants which were projected to operate beyond 1977.

2. A total of 4 additional small plant closures are expected to shutdown due to the added financial burden of pollution controls. Eight to ten other small plants (primarily apple slices and sauce) would be impacted severely, but it is estimated that treatment systems are already in place.

Total Production Lost Due to Guidelines

The estimated short-term production lost from the 2 citrus juice plants which are forced to shutdown due to the control guidelines is 6 percent of the total single strength output. This percentage loss should be recoverable among existing plants within a short period based on estimated underutilization of capacity.

The 4 apple products processing plants are all estimated small plant shutdowns and the total production lost is approximately 4 percent of the apple slices and sauce output. Again, this percentage loss should be picked-up by other processors.

On an industry-wide basis the primary forced shutdown production losses should be recoverable. However, the baseline rapid-closure pattern expected in 1977 will cause more serious adjustment problems in the industry. For example, in 1977 with fewer plants, the 10 citrus remaining baseline closures would represent about 11 percent of the plants in the citrus industry.

Also in 1977, the remaining baseline closures of 13 apple products plants would represent about 10 percent of the total apple processors. Total production lost should be substantially lower than these percentages since most closures are expected to be small plants. However, the adjustment problems could be serious both in terms of short term production and local community and employment impacts.

## D. Employment Effects

Total employment in 1972 in the citrus processing industry is estimated at about 18,615 and at 25,155 in the apple products processing industry. Approximate estimates of 55, 145 and 400 employees have been made for small, medium and large plants, respectively in each of these industries. The above estimates reflect "average monthly" employment per plant only. Peak season employment is often 2 to 2.5 times larger with part-time employees added to meet seasonal requirements.

For the two forced shutdowns in the citrus industry (beyond baseline), the employment losses would represent less than 1.5 percent of the industry employment (one medium and one small plant assumed). In the apple processing industry, the four small plant closures would represent less than .5 percent of the total employment.

Again, it is emphasized that the rapid closure of "baseline" plants in 1977 will present probable adjustment problems which can only be partially attributed to pollution control impacts.

Employment displacements in these industries are not expected to be absorbed by more than about 10 percent in the remaining plants in the industry. Most remaining plants will tend to be more capital intensive. Some additional skilled labor may be transferable; but additional production workers, if needed, would tend to come from local labor forces.

Employment on farms (orchards) is not expected to change significantly on the assumption that alternate processors will be available within a feasible delivery range. In case an alternate processor is not available then serious orchard losses and associated farm employment reductions would occur.

## E. Community Effects

Citrus and apple processing plants often are a vital economic factor in the communities in which the plants are located. Thus, while only few plants are projected to be forced to shutdown, local impacts could be severe.

In information developed by the National Canners Association pertaining to some 400+ fruit and vegetable processing plants which might close in the future in relation to pollution controls, the following "average" characteristics were derived for each plant closure situation:

- 63 full time employees involved
- 72 part time employees involved
- 33 farmers affected
- $700,000 local payrolls, expenditures involved
- $1.4 - 2.1 million local economic activity (multiplier effect) involved
- 50 percent of such plants in or near towns with less than 2,500
- 75 percent of such plants in or near towns with less than 5,000

From this general information, the approximate levels of local community effects can be assessed.

The exact location of the plants which are most likely to close has not been established. However, it is noted that the principal citrus producing areas are in Florida, Texas, California and Arizona. Major apple producing and processing areas are in New York, Michigan, Maryland, Pennsylvania, Virginia, California, Washington, Oregon and Idaho. More information on plant location is included in Chapter II.

## F. Other Effects

A potential concern exists regarding international trade and balance of payments consequences of pollution control impacts on the citrus and apple processing industries. For example, 41.5 percent of the 1970 pack of canned orange juice (single strength and concentrated) was exported. Thus, any major reduction in production could result in losses of exports and declining balance of trade consequences. However, as estimated above, production levels of single strength orange juice are expected to be maintained (despite a loss of 6 percent from plants which are forced to shutdown).

On the other hand, the U.S. is a net importer of processed apple products, e.g., apple juice, representing about 45 percent of the U.S. pack in 1970. In this case, only apple slices and sauce processing plants were expected to be impacted. Thus, no major international trade implications are involved. However, product mixes could vary and relatively more or less apple juice could be produced. Any substitution from juice to sauce or slices could result in increased apple juice imports and a net decline in the balance of trade. More detailed export and import data are presented, by product in Chapter IV.

## G. Summary of Impacts

The foregoing analysis of the citrus and apple processing industries indicates that specific segments of these industries are likely to be impacted severely on the basis of model plant effects. A broad range of effects were considered and a brief summary of the main effects estimated for both BPT and BAT levels of control is as follows:

| Type of Impact | BPT (1977) | BAT (1983) |
|---|---|---|
| 1. Price Effects | | |
| Orange Juice - large plants | .5 - .8% | .9 - 1.1% |
| Apples - large plants | .4 - .9% | .5 - 1.3% |
| 2. Financial Effects | All S.S. Orange Juice and small apple slices and sauce plants incur losses. Plant shut-downs expected. | Same as BPT |
| 3. Production Effects | | |
| . Citrus plant shutdowns | | |
| Baseline | 8 | 10 |
| Above Baseline | 2(+10 Baseline) | - |
| . Apple plant shutdowns | | |
| Baseline - No. plants | 12 | 13 |
| Above Baseline - No. Plants | 4(+13 Baseline) | - |
| . Production losses (short-term) | | |
| Citrus - Above Baseline | 6%(+Baseline) | |
| Apples - Above Baseline | 4%(+ Baseline) | |
| 4. Employment Effects | | |
| Citrus - Above Baseline | 1.5%(+Baseline) | |
| Apples - Above Baseline | .5%(+Baseline) | |
| 5. Community Effects | | |
| Citrus and apples | Employee losses<br>Payroll losses<br>Local multiplier effect loss<br>Farmer impact possible | |
| 6. Other Effects | | |
| Citrus | Potential loss in experts of canned juice | |
| Apples | Potential increase of imports of apple juice | |

# VIII. LIMITS OF THE ANALYSIS

The foregoing impact analysis was based upon data and information from published secondary data, annual company reports, financial statistics services, private sources and the Contrator's files. The various data are subject to error and variance. The purpose of this final section is to present the limits of the analysis in terms of accuracy, range of error, critical assumptions and remaining questions to be considered.

## A. General Accuracy

Key financial information on the fruit and vegetable industry is generally scarce, particularly for individual plants or firms. Consequently, the financial aspects of the impact analysis were, of necessity, based upon synthesized costs and returns for model plants representing the various segments studied. In developing these model data, efforts were devoted to evaluating and cross checking these materials wherever possible.

Fruit and vegetable processing plants generally process a mix of products and product forms. For example, apple processors will often produce apple juice, sauce and slices as well as other fruit products such as peaches and pears. Vegetable plants virtually always process multiple species. Further, in processing multiple products, some plants in the industry are relatively large, in terms of total plant throughput.

These characteristics (large number of product mixes) make it difficult to model the various industry segments. To handle this situation, plant models were developed on single product basis. These models were sized to typical throughputs of that product. It is recognized that this procedure may not fully reflect cost savings through the use of common facilities by several products.

Due to severe budget constraints and a paucity of financial data, this analysis used frozen and single strength orange juice plants as surrogates for the citrus oil, sections and peel products segments. The procedure may have reduced the accuracy of the impact analysis, but it is believed that the inferences drawn are of an acceptable order of magnitude.

Specifications of the contract called for the Contractor to use effluent control costs provided by EPA. The contract precluded detailed comment on these costs and technology by this Contractor. The cost data provided were for two discrete plant sizes which did not correspond with plant sizes used in this analysis. Linear extrapolations of the provided cost data were made by the Contractor to obtain the needed data. It is quite conceivable that the cost-size relationships may be non-linear, but information on this was not provided. To the extent this relationship deviates from a linear one, the effluent control costs used in the model plant analysis may be misstated.

## B. Possible Range of Error

Different data series and portions of the results of the impact analysis are subject to error and variance with the industry. Estimated error ranges of key items as an order of magnitude, are as follows:

| | | Error range (Pct.) |
|---|---|---|
| 1. | Number, location, capacity, product mix of plants | ± 10 |
| 2. | Price data for products and raw materials | ± 10 |
| 3. | Sunk investment value | ± 20 |
| 4. | Plant operating costs | ± 10 |
| 5. | Effluent control costs | Not estimated |
| 6. | Expected price changes | ± 5 |
| 7. | Estimated plant closures | ± 20 |

## C. Critical Assumptions

In an analysis of this sort, a number of underlying assumptions are required. Some of the more critical assumptions used in this analysis are given below:

1. As indicated in the above discussion on general accuracy, single product model plants were used as the basis of the analysis. It was assumed that they would be indicative of the reactions of corresponding multiproduct units.

2. It was further assumed that frozen and single strength orange juice plants would serve as proxies for the other citrus products-sections, oil and peeled products.

3. Linear cost-size relationships of effluent control investment and annual costs were assumed in estimating these costs for the model plants.

4. Constant 1972 prices and costs were used for each of the model plants for the period of analysis. This is based upon the assumption that inflation will influence both proportionately. There is some evidence that effluent control costs are rising at a rate faster than the general price level, which may lead to an understatement of the 1977 and 1983 effluent control investment.

5. Plant throughput was held constant for the period of analysis, although the various types of plants varied in length of operating season (Table III-1). In practice, it should be recognized that due to weather conditions, crop quality and other factors, that year to year variations of throughput will occur.

6. Based on sample data of the various industry segments, approximately two-thirds of the plants were assumed to have either existing municipal system hookups or land-irrigation disposal systems in place that would meet BAT standards. Only the remaining third with partial or no treatment facilities would require additional investment to meet BPT and/or BAT. (See Table VI-10 for summary.)

7. Alternative effluent control technologies were provided by EPA, along with a set of assumptions regarding the number of plants that would employ each type of technology. The

schedule of BPT and BAT technology (including further municipal hookups) is presented in Table VI-10. The impact analysis was based upon these assumptions. It turns out, in most cases, that the conclusions regarding impact of the effluent controls are similar for each of the alternative technologies.

8. Cost data were not provided regarding new municipal hookups by these fruit and vegetable plants. Since data were not provided, the number of plants assumed to follow this alternative were excluded from the closure estimates, to the extent these hookups would involve substantial new costs, estimated potential closures may be understated.

## D. Remaining Questions

Use of the model plant approach obviously results in question of its representativeness. Although any rigorous analysis of the type this report reflects would require the use of representative plants, given a larger budget the analyst could use a larger number of models and perhaps better reflect the economics of the industry. This question of representativeness of the model plants can only be answered by further detailed analysis.

Although several treatment strategies were examined, land based technologies dominated. This raises questions regarding the availability and cost of land for land based disposal techniques. High land costs could lead to a greater impact then estimated in this report. Answers to these questions would require further industry surveys on this issue.

Another unresolved question as of this writing is the impact of effluent controls on the potato processing segment. As previously pointed out in the Phase I report and subsequent memos from the contractor to EPA, this required financial data for this segment are virtually non-existent. Efforts to obtain and/or synthesize these data have proven unsuccessful. Given this situation, it is suggested that the best alternative, short of an extended project,to obtain an insight into an order of magnitude impact of pollution control costs on the potato processing industry would be a comparison of unit effluent control costs with wholesale prices.

Because many fruit and vegetable processing plants process a number of products, in addition to those which were included in the proposed effluent limitations guidelines, an obvious question arises as to what constitutes an apple or a citrus processing plant. Presumably some sort of concentration ratio would have to be established, and any plant which was above that ratio would be classed as that sort of plant. This definitional difficulty, of course, gave rise to the problems of estimating the industry economics discussed above.

# APPENDIX A

# APPENDIX A

## Preliminary Potato Processing Industry Economic Impact of Costs of Proposed Effluent Limitation Guidelines

An unresolved question is the expected economic impact of effluent controls on the potato processing industry. Proposed effluent guidelines have been established, and estimated investment and operating costs for specified plants have been developed. However, plant financial data to which the incremental pollution control costs would apply were not available from secondary sources nor obtainable by DPRA from extensive contacts with trade association and private industry sources.

A preliminary insight into expected impacts of pollution control costs is possible through comparison of unit effluent control costs with wholesale prices of processed potatoes. The purpose of this brief summary is to estimate both unit costs and prices and derive a cost/price ratio which would indicate the general magnitude of price increase required to cover the incremental pollution control costs.

In this assessment, two major subcategories of potato processing operations are involved:

1. Frozen potato products
2. Dehydrated potato products

These subcategories represent the major potato processing categories. For example, in 1970, all processed potatoes were distributed approximately as follows in terms of fresh weight equivalent:

| Process | 1970 % Distribution |
|---|---|
| Frozen | 47% |
| Dehydrated | 30 |
| Chips | 22 |
| Canned | 1 |
| Total Processed | 100% |

Further the ratio of processed to fresh potato consumption has been steadily increasing with a 50/50 ratio occurring in 1970. By 1980, it is estimated that processed products will account for about three-fourths of the total food use of potatoes (Figure A-1).

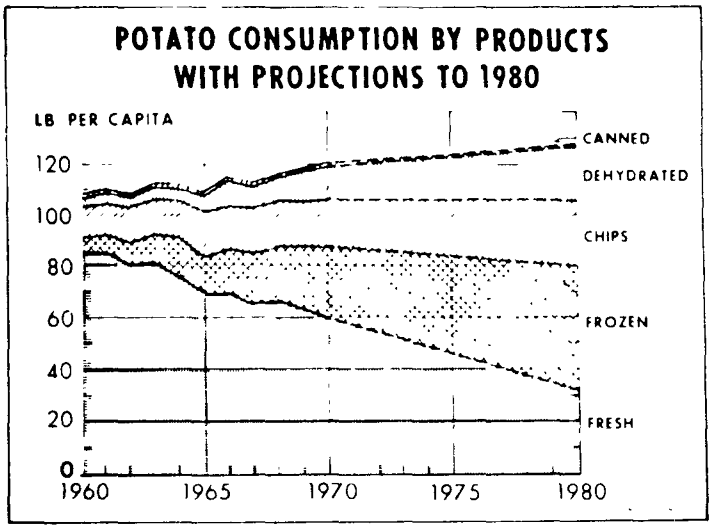

Figure A-1

Source: Vegetable Situation, ERS, USDA, TVS-186, October, 1972

Within the frozen potato category, frozen french fries are the dominant product packed (85-90%). The balance includes hash browns (5-7%) and miscellaneous other products (5-8%).

A variety of dehydrated potato products are also produced, e. g., granules, flakes, slices, and diced potatoes. A percentage breakdown of these products is not known at this time, but granules are a major product.

## Water Pollution Control Costs

In information supplied by EPA (Ben Holt Co.), water pollution control standards (see Tables VI-1 and VI-2) and associated treatment costs were provided for both the frozen potato and the dehydrated potato products categories. A summary of the estimated pollution control costs as provided are shown in Table A-1. For each process category, costs are shown for two sizes of operations as specified. Also, both estimated investment and annual operating costs are shown. Further, a series of alternative treatment strategies are proposed: B and E are BPT alternatives; C, F and G are BAT alternatives; and D provides both BPT and BAT control.

For reference, an outline description of the treatment components involved in each alternative strategy are as indicated in Table A-2. It is noted that the following combinations of treatment strategies are designed to first provide BPT and then BAT levels of control. B to C; E to F or G; and D (spray irrigation) for both BPT and BAT control.

An objective herein is to derive pollution control cost estimates in terms of units (e. g., cwt.) of product packed. To do so, the following operating assumptions were made:

| Operating Characteristic | Assumption |
|---|---|
| 1. Conversion factor from raw product to processed weight: [1] | |
| a. Frozen products | .4 |
| b. Dehydrated products | .14 |
| 2. Operating days per year | 250 |
| 3. Thruput per day (raw product) | Same as provided |

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[1] Conversion factors based on: Conversion Factors and Weights and Measures, for Agricultural Commodities and Their Products, Statistical Bulletin No. 362, USDA, ERS, June, 1965.

Table A-1. Summary of investment (I) and annual cost (AC) data for water pollution control for selected potato processing plants [1]

| Treatment Practice and Type Cost | | Frozen Potato Products Plant Data | | Dehydrated Potato Products Plant Data | |
|---|---|---|---|---|---|
| | | 400TPD(S) ($000) | 1,000TPD(L) ($000) | 350TPD(S) ($000) | 1,000TPD(L) ($000) |
| Treatment B: | I | 505.2 | 1,051.0 | 273.3 | 586.9 |
| | AC | 100.7 | 188.9 | 49.6 | 113.0 |
| Treatment C: | I | 728.2 | 1,525.0 | 383.3 | 842.9 |
| | AC | 144.5 | 273.6 | 75.4 | 162.0 |
| Treatment D: | I | 469.1 | 1,140.3 | 217.1 | 555.1 |
| | AC | 94.8 | 246.5 | 41.6 | 114.1 |
| Treatment E: | I | 902.2 | 1,826.0 | 498.3 | 1,011.9 |
| | AC | 67.0 | 151.7 | 32.6 | 80.0 |
| Treatment F: | I | 1,009.2 | 2,038.0 | 559.3 | 1,131.9 |
| | AC | 81.9 | 176.2 | 42.7 | 96.2 |
| Treatment G: | I | 1,089.2 | 2,213.0 | 599.3 | 1,223.9 |
| | | 99.9 | 211.2 | 53.7 | 116.2 |

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[1] Data provided by EPA. Supplement Tables 33 and 34 to the Development Document prepared by the Ben Holt Co.

Table A-2. Summary of treatment components for alternative strategies of effluent reduction: Frozen Potato Products and Dehydrated Potato Products

| Treatment Component | Alternative Strategies for Frozen Potato Products | | | | | | Alternative Strategies for Dehydrated Potato Products | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B | C | D | E | F | G | B | C | D | E | F | G |
| Screening (Level A) | X | X | X | X | X | X | X | X | X | X | X | X |
| Primary Sedimentation | X | X | X | X | X | X | X | X | X | X | X | X |
| Shallow Lagoon (30 day rentention) | | X | X | | | | | X | X | | | |
| Aerated Lagoon -- Settling | X | X | | | | X | X | X | | | | |
| Aerated Lagoon -- No Settling | X | X | | | | | | X | | | | |
| Anaerobic/Aerobic Lagoon | X | X | | | | | X | X | | | | |
| Activated Sludge | | | | X | X | X | | | | X | X | X |
| Sand Filtration | | | | | X | X | | | | | X | X |
| Spray Irrigation | | | X | | | | | | X | | | |

Source: EPA and the Ben Holt Co., Inc. Levels B and E are alternative BPT control strategies, levels C, F and G are alternative BAT control strategies, level D provides both BPT and BAT effluent reductions.

Given the pollution control costs as shown in Table A-1 and the operating assumptions above, then estimated control costs per unit (cwt.) of final product for selected frozen potato and dehydrated potato processing plants are as shown in Table A-3. Investment costs were converted to an annual basis by including depreciation and interest costs as noted in the table.

The control costs in Table A-3 are subsequently summarized by product category in terms of BPT and BAT treatment strategies. The unit costs shown are the basic matrix of cost components required for the proposed unit control cost/wholesale value ratio analysis.

## Estimated Wholesale Values

Wholesale prices (or f.o.b. plant prices) for frozen and dehydrated potato products are not publically reported or available. Large institutional buyers, food chains and secondary processors (e.g. General Foods) often negotiate contracts with potato processors and such contracts are confidential. Thus, it is difficult to estimate wholesale values for either frozen or dehydrated potato products.

The approach taken herein was to contact selected institutional buyers in the Mid-west and solicit prices paid for various processed potato products. The results of these inquiries are not purported to reflect industry-wide averages. However, the general magnitude of prices per hundredweight for frozen and dehydrated potato products are considered acceptable for this very preliminary assessment.

A summary of estimated "average" values for selected frozen and dehydrated potato products and relative weights for calculating composite values is as follows:

| Process and Product | Sample "Average" 1972 Value/lb | Relative Weight |
|---|---|---|
| Frozen Potato Products | | |
| French Fries | .17 | 90% |
| Hash Browns | .20 | 5% |
| Other | .18 | 5% |
| Dehydrated Potato Products | | |
| Granules, Flakes | .28 | 75% [1] |
| Other | .40 | 25% |

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[1] Assumed relative weights for dehydrated products.

Table A-3. Summary of estimated water pollution control costs per unit of final product for selected frozen potato and dehydrated potato products plants

| | Frozen Potato Products | | Dehydrated Potato Products | |
|---|---|---|---|---|
| Item | Small Plant | Large Plant | Small Plant | Large Plant |
| TPD Raw Product 1/ | 400 | 1,000 | 350 | 1,000 |
| TPY-Annual Raw Product 2/ | 100,000 | 250,000 | 87,500 | 250,000 |
| TPY-Finished Product 3/ | 40,000 | 100,000 | 12,250 | 35,000 |
| Pollution Control Costs, 4/ $ per swt. | | | | |
| Treatment Alternative and Cost Component | | | | |
| B: Depreciation | .042 | .035 | .074 | .056 |
| Interest | .051 | .042 | .089 | .067 |
| Operating Cost | .126 | .094 | .202 | .161 |
| Total cost/cwt. | .22 | .17 | .37 | .28 |
| C: Depreciation | .061 | .051 | .104 | .080 |
| Interest | .073 | .061 | .125 | .096 |
| Operating Cost | .181 | .137 | .308 | .231 |
| Total cost/cwt | .32 | .25 | .54 | .41 |
| D: Depreciation | .039 | .038 | .059 | .053 |
| Interest | .047 | .046 | .071 | .063 |
| Operating Cost | .119 | .123 | .170 | .163 |
| Total cost/cwt. | .21 | .21 | .30 | .28 |
| E: Depreciation | .075 | .073 | .127 | .096 |
| Interest | .090 | .061 | .153 | .116 |
| Operating Cost | .084 | .076 | .133 | .114 |
| Total cost/cwt. | .25 | .21 | .41 | .33 |
| F: Depreciation | .084 | .068 | .153 | .108 |
| Interest | .101 | .082 | .183 | .129 |
| Operating Cost | .102 | .088 | .174 | .137 |
| Total cost/cwt. | .29 | .24 | .51 | .37 |
| G: Depreciation | .091 | .074 | .163 | .117 |
| Interest | .109 | .089 | .196 | .140 |
| Operating Cost | .125 | .106 | .219 | .166 |
| Total cost/cwt. | .33 | .27 | .58 | .42 |

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1/ TPD equals Tons Per Day. Sizes provided by EPA and the Ben Holt Co.

2/ TPY equals Tons Per Year. Based upon 250 operating days per year.

3/ Finished product yields based on conversion factors from raw product of .4 for frozen products and .14 for dehydrated potato products.

4/ Basic investment and annual operating cost data as provided. Depreciation calculated as .067 times investment, Interest as .08 times one-half of total investment, and Operating Cost as given divided by cwt. of finished product.

For purposes of this analysis, composite (weighted) wholesale values per hundredweight unit of processed potatoes are estimated as:

| | Composite Wholesale Value/cwt. |
|---|---|
| Frozen potato products | $17.20 |
| Dehydrated potato products | $31.00 |

## Comparison of Unit Control Costs and Wholesale Values

The results of the two preceding sections can now be combined to approximate the percent price increase required to recover the costs for water pollution control:

$$\text{Approximate Percent Price Increase} = \frac{\text{Control Cost/cwt}}{\text{Wholesale Value/cwt}}$$

This ratio can be computed for both small and large plants, and for all treatment strategies as shown in Table A-3.

A more condensed summary of the estimated water pollution control costs per cwt. as presented in Table A-3 are shown in Table A-4. Also, the costs are shown in relation to either the BPT or BAT levels of control as has been described.

Next, using the computed wholesale values above, the percent price increases required to recover the control costs (as indicated in Table A-4) are as presented in Table A-5.

Table A-4. Summary of estimated water pollution control costs per cwt. of product for small and large frozen and dehydrated potato processing plants [1/]

| Type of Product and Plant Size | Range of Control Costs per Cwt. | | |
|---|---|---|---|
| | BPT | BAT | "D" (Both) |
| | ($/cwt) | ($/cwt) | ($/cwt.) |
| Frozen Potato Products | | | |
| Small Plant (400 TPD) | .22-.25 | .29-.33 | .21 |
| Large Plant (1,000 TPD) | .17-.21 | .24-.27 | .21 |
| Dehydrated Potato Products | | | |
| Small Plant (350 TPD) | .37-.41 | .51-.58 | .30 |
| Large Plant (1,000 TPD) | .28-.33 | .37-.42 | .28 |

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[1/] Summarized from Table A-1. BPT level involves treatment strategies C or E; BAT involves C, F or G; and D meets both BPT and BAT requirements.

Table A-5. Summary of estimated percentage increases in wholesale processed potato prices needed to recover proposed water pollution control costs

| Type of Product and Plant Size | Approx. Wholesale Value/cwt | Percent Increase in Price Needed to Recover Pollution Control Costs [1/] | | |
|---|---|---|---|---|
| | | BPT | BAT | "D"(Both |
| | | (%) | (%) | (%) |
| Frozen Potato Products | $17.20 | | | |
| Small Plant (400 TPD) | | 1.3-1.5 | 1.7-1.9 | 1.2 |
| Large Plant (1,000 TPD) | | 1.0-1.2 | 1.4-1.6 | 1.2 |
| Dehydrated Potato Products | $31.00 | | | |
| Small Plant (350 TPD) | | 1.2-1.3 | 1.6-1.9 | 1.0 |
| Large Plant(1,000 TPD) | | 0.9-1.1 | 1.2-1.4 | 0.9 |

[1/] Ranges based on alternative treatment strategies as provided: BPT involves alternatives B and E; BAT involves C, F. or G; and D meets both BPT and BAT requirements as previously described.

For frozen potato products plants, the range of estimated price increases are from 1.0 to 1.5% for BPT control and from 1.2 to 1.9% for BAT control. These ranges include small and large plants as defined. The higher percentages reflect small plant impacts, but it is noted that "small" plants, as defined, are not impacted on a unit cost basis as severely as generally expected relative to the large plants.

For the dehydrated potato products plants, similar price increase estimates range from .9 to 1.3% for BPT control and from .9 to 1.9% for BAT control. As further illustrated in Table A-5, the differential impacts among small and large plants are not extremely large based on the control cost data provided.

Further weighting of the percentage price increases to reflect possible combinations of treatment strategies which might be used, and/or to reflect proportions of pack by small and large plants could be applied to the data developed. However, given the reliability of present information regarding the potato processing industry, such additional calculations are not warranted. The intent of this supplemental analysis is to provide a preliminary assessment of expected impacts despite very limited availability of desired industry data.

## Additional Considerations

The above "price effects" are intended only to reflect the general order of magnitude of price increases which might be involved as a consequence of the proposed effluent limitation guidelines.[1] There are various additional related effects which are even more tenuous given available information. For example, probable plant shutdowns because of financial effects and/or production curtailments cannot be specifically assessed. Neither is it possible to evaluate expected employment effects and community effects which would likely accompany plant shutdowns.

While the related effects cannot be directly estimated, it is noted that the preliminary price effects are of a magnitude which is similar to other fruit and vegetable processing industries. In other words, potato processors do not appear to face control costs on a unit basis which are relatively greater than other types of fruit and vegetable processors.

[1] As noted below, about 60 percent of the potato processors are estimated to either have municipal sewer hook-ups or land disposal systems in place. The price effects described assumed no pollution controls in place. Thus, the industry-wide consequences would be less than the effects described.

As reported in Table VI-8, it is further noted that about 60 percent of the potato processors are estimated to currently have either municipal sewer hook-ups (12%) or land irrigation disposal systems (47%). Another 31 percent are estimated to have some biological treatment practices, and only 10 percent are indicated to have no treatment at present (based on sample data only).

Industry-wide impacts of pollution control costs will be mitigated substantially because of the relatively high percentages of plants which have either municipal or land disposal systems. The former plants are not directly affected by the proposed guidelines, and the latter plants employ a treatment strategy which is indicated acceptable to meet the proposed guidelines.

Based on materials presented in Chapter II, 103 potato processing plants were identified by type as follows:

| Type of Potato Processing Plant | Number, 1972 |
|---|---|
| Freezer | 32 |
| Dehydrator | 6 |
| Freezer and Dehydrator | 8 |
| Canner and Freezer | 6 |
| Canner and Dehydrator | 2 |
| Canner only | 49 |
| | 103 |

These data were obtained from The Directory of the Fruit and Vegetable Canning, Freezing, and Preserving Industries, 1972-73. This source of plant data is not necessarily exhaustive, especially for potato dehydrators. Additional study is needed to more completely identify potato processors in the U.S. (A total of 114 processing plants were indicated in Table II-7 in the Ben Holt Co. report, but not specified by type of process.)

A much more thorough analysis and assessment of expected impacts of water pollution controls on the potato processing industry is desired and recommended. Data which does not now exist on an industry-wide basis needs to be developed; and this is only possible with the close cooperation of industry sources.

In conclusion, the level of expected price effects as suggested in this preliminary analysis indicates that the potato processing industry will not likely be impacted severely relative to other food processing industries. Also, extreme differential impacts among varied sizes of plants are not indicated.

**BIBLIOGRAPHIC DATA SHEET**

1. Report No. EPA-230/1-73-012

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15. Supplementary Notes

16. Abstracts

The economic impacts of proposed effluent guidelines on selected portions (citrus, apples and potatoes) of the fruit and vegetable processing industry were assessed. The analysis included description and statistical compilations regarding the number, location and characteristics of types of firms and plants; financial profiles, investments, operating costs and returns for selected model plants; prices and pricing mechanisms, description of analytical procedures employed; evaluation of costs of proposed effluent treatment practices; and economic impacts of proposed pollution controls in terms of effects on prices, industry returns, production, employment, community economics and international trade. Limits of the analysis were stated.

Specific segments of the citrus (single strength canned juice) and apple (small slices and sauce plants) processing industries will be severely impacted both by the BPT (1977) and BAT (1983) levels of control. Some plants are projected to shutdown

17. Key Words and Document Analysis. 17a. Descriptors

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**16.** Abstract (continued)

due to control requirements including a more rapid closure of plants which might otherwise operate until equipment was worn-out.

Approximately two-thirds of the plants involved are reported either to be linked to municipal treatment systems or to have land disposal (spray irrigation) systems. According to EPA these systems will meet control requirements. Because of this, overall industry impacts are effectively reduced. However, individual plants projected to shutdown will cause serious local community effects including employment losses that often cannot be readily absorbed in the affected communities.