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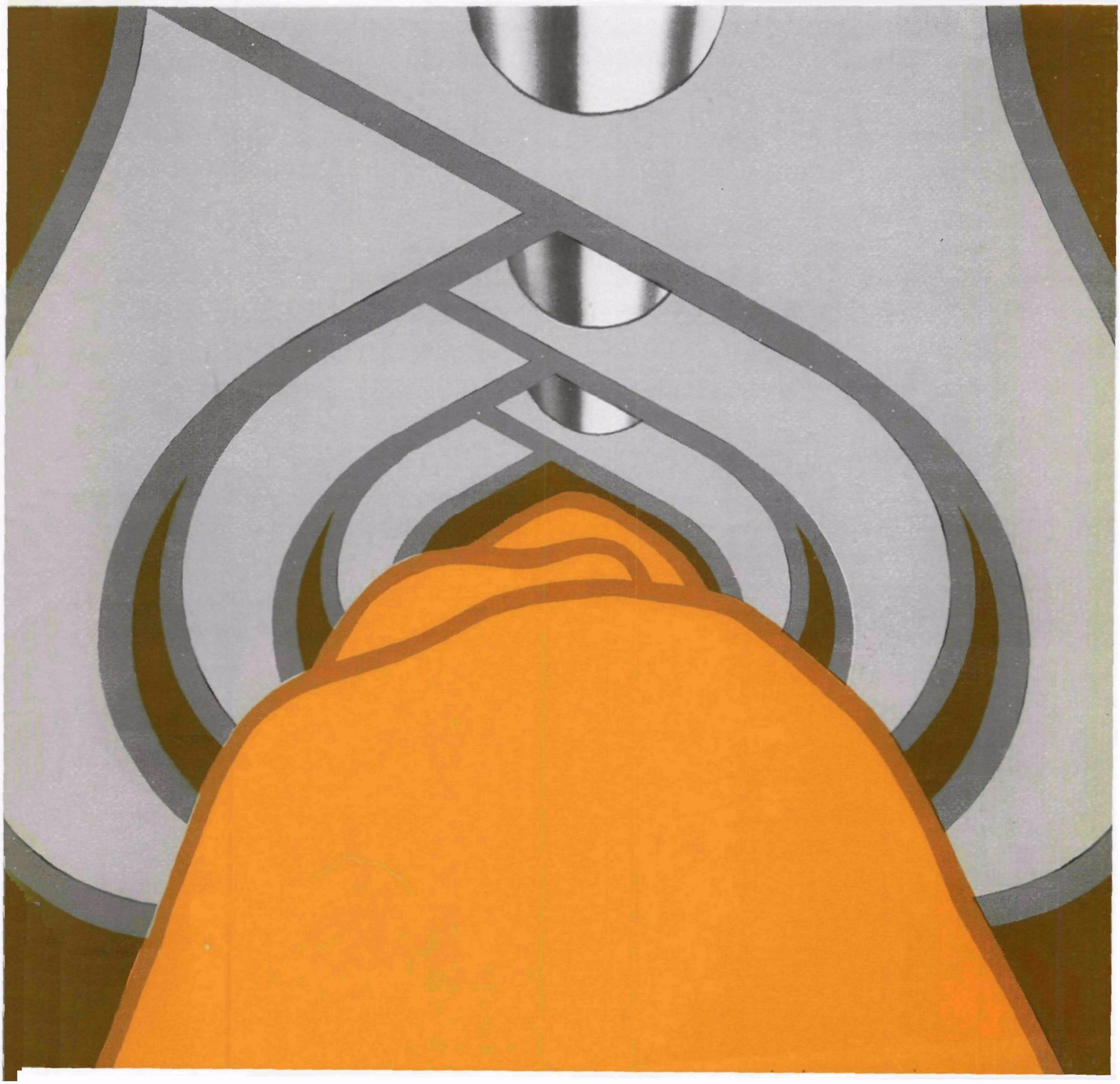
Choosing the Optimum Financial Strategy

Upgrading Meat Packing Facilities to Reduce Pollution

EPA Technology Transfer Seminar Publication



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Upgrading Meat Packing Facilities to Reduce Pollution

ENVIRONMENTAL PROTECTION AGENCY • Technology Transfer

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FOREWORD

Much has been written on how to select pollution-control equipment, but relatively little on how to pay for it. A sound capital investment strategy, however, can mean the difference between profitable operation and controlled cash flow, on the one hand, and fiscal chaos on the other. This report is an explanation of how some proven tax and financing strategies, and their use in various combinations, can help the financial position of three hypothetical meat packing operations, with differing management goals, facing capital equipment expenditures. For the meat packers who have a choice between onsite treatment and sending their pretreated wastes to a municipal system, a method of financial analysis of these alternatives also is presented.

No matter how adept and capable a financial manager may be, it is entirely possible that he could overlook some important aspect of fiscal management of pollution-control expenditures, because of the new and unique nature of the legislation, the high degree of complexity, and the one-shot nature of the decision. This report was prepared especially for the Environmental Protection Agency Technology Transfer Seminar for meat packers. It shows the small businessman the type of financial analysis that should be accorded a pollution-control expenditure, because of the possibilities of substantially reducing the funds expended and of smoothing out the cash flow trauma that otherwise could develop.

The report has been tailored to the meat packing industry engaged in slaughtering and processing, but not in processing alone. The meat packing industry is faced with several Federal regulatory programs, of which water-pollution control represents the most significant dollar outlay. The financial laws and analytical techniques, however, have applicability to all air and occupational-safety-and-health situations for any industry.

This report primarily focuses on areas such as the stunning, bleeding, cutting, eviscerating, and processing phases of curing; therefore, wastewater is the major pollution situation considered. Wastewaters from domestic use and boiler and cleaning operations are minor organic sources that, while included in the definition of wastewaters, are not discussed in the report.

The analysis is applicable to meat packers with their own treatment facilities and to those whose facilities connect with the municipal system. At present, 60-70 percent of all meat packing effluent goes to municipal facilities; the remainder, with some form of treatment, goes from the meat packers to receiving streams. This mix is subject to the possibility of substantial change, owing to the higher user charges to be faced in the future, brought about by the Federal Water Pollution Control Act and new standards for private treatment.

The illustrative situations used in this presentation are necessarily simplified; they are representative examples that by no means exhaust the variety of available alternative tax and financing strategies, particularly those relating to pollution-control equipment. Much financing—and, to a lesser extent, tax treatment—varies by jurisdiction. Thus, it is necessary to consult the latest tax rulings and legislation governing in the particular location before undertaking final decisionmaking.

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Chapter I

INTRODUCTION

As the 1970's proceed, environment-related management decisions will be more complex and frequent. The impact on businesses of nonproductive environmental expenditures can be significant where byproduct recovery is limited or nonexistent. It is clear from provisions of the 1972 Federal Water Pollution Control Act (FWPCA) amendments (Public Law 92-500), coupled with the existing Clean Air Act, that industry must commit sizable capital to meet the environmental standards the Nation has set.

Many governmental institutions have shown compassion for the necessary private equipment expenditures and public treatment facilities by providing means of reducing or softening the financial expenditures for pollution control. There exists a mild governmental practice of spreading some of industry's pollution-control costs over the general public instead of restricting them to the company and, to some degree, its customers. This spread is accomplished by excusing pollution-control devices from certain sales, use, and property taxes, by allowing tax-exempt financing by the company of the expenditures, or through adjustment in company income taxes by the addition of special depreciation alternatives. All these programs result in the company's paying lower taxes than would be the case if the equipment were used for some other manufacturing or service purpose. Another set of incentives provides for the possibility of government treatment of wastes at lower costs than self-treatment through Federal Government grant programs.

To put these incentives or cost reduction practices into perspective, it should be pointed out that they do not pay for the pollution-control investment, nor do they overwhelmingly reduce the cost; however, they can have a pronounced effect on cash flow and profit positions, depending on the alternatives selected. Because procurement of control equipment is a relatively unusual business occurrence, and because of a considerable body of new and involved tax and financing regulations for such a purpose, it is likely that company financial managers are less familiar with the many possibilities than they would be with the more common business operations.

This report will demonstrate that it is well worth spending time in analyzing the innovative methods of financing pollution expenditures and their equally innovative tax treatment. The report will alert decisionmakers as to the availability of and qualifications for some of the financing incentives that Federal, State, and local governments have made available.

Obtaining the optimum financial and tax incentives for a company could save tens of thousands of dollars over the life of the equipment. For example, a recent article[1] demonstrated the cost savings that tax-exempt pollution-control revenue bonds can provide. "Over the life of a 20 year $10 million issue, the typical interest saving is about $3.6 million." Some revenue bond issues allow for deferred repayments of principal, and permit the largest payments at the end of a 20-30-year issue. Meanwhile, the company can take depreciations and use investment tax credits that lower taxes. Thus, it can build up a cash flow that is used in other areas of the business. On that cash flow, earnings are generated that help to repay the bond principal at the later time.

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[1] *Business Week*, pp. 50-51, July 29, 1972.

On balance, more of this report is devoted to the financial analysis for equipment purchases than to user charge analysis, for the following reasons:

- First, most industries will face equipment purchases for onsite treatment or municipal treatment since the latter alternative requires pretreatment.

- Second, other regulatory programs, for example, the Clean Air Act, normally show their impact through required capital equipment expenditures.

The financial techniques used in examining pollution-control expenditures are well established; however, the future costs to be analyzed are only beginning to become apparent. Under the enforcement provisions of the FWPCA's National Pollutant Discharge Elimination System, effluent guidelines relating to the best practicable technology have been issued specifically for many industries treating on site. These guidelines give many companies an idea of how they will be required to control by 1977, but final cost estimates may not be ascertainable until compliance terms of a given company's specific permit are set and issued.

For costs of discharging to municipal facilities, pretreatment guidelines from EPA are expected momentarily. The other major cost factor, user charges for those who hook into municipal facilities that receive Federal grants, will not become accurately known until late 1973. These costs consist of the equitable cost apportionment of recovering the capital and operating and maintenance costs of the company's portion of municipal treatment costs. Once the EPA completes its process, meat packers and others then will be able to determine whether it would be financially preferable to make a capital equipment investment for their own private treatment facilities, or whether being hooked into a municipal treatment system would be better. There may be regulations, however, that would preclude the exercise of the results of such a decision. This report will indicate how to proceed with an analysis once the permissibility and costs of using municipal facilities are defined more adequately.

MANAGEMENT SUMMARY AND GUIDE

It has been noted here that there are a number of innovative alternatives that have sizable, differing financial consequences amounting to tens of thousands of dollars. Many of the alternatives require, by law, that once a financial decision is made it cannot be changed, or it can be changed in only one direction. Other decisions are final in that it would be prohibitively costly to change later on in the program. Therefore, the following five steps should be taken in analyzing financial information as a minimum before equipment or charge decisions are made:

1. Determine for all debt financing of pollution-control investments the most effective combination of rate and term of the loan. Calculate the negative cash flows involved and their net present values.

2. Calculate the year-by-year cash inflows and the present values for each available choice of depreciation.

3. Select the management objective by which it would be desirable to judge the financial impact of the investment in equipment; for example, lowest short term profit impairment, least cash drain, long term profit impairment. Compare the combinations of financing and depreciation values calculated in steps 1 and 2 against the established management objective, and select the combination best suited for company needs.

4. Determine what the municipality's user charge will be for processing wastes, and estimate the capital expenditure necessary for any pretreatment facility. Calculate the present values for the treatment expense and a present lease value for the user charge payment.

5. Compare the values and year-by-year effects of step 4 and steps 1-3 against the selected financial management objective. This comparison will allow a choice between plugging into municipal wastewater or investing in a private treatment facility, from a financial point of view.

This analysis presumes that the legal and tax implications of each financial alternative are understood fully by the analyst in order that present values and cash flows can be calculated. The analysis does not include the legislative and technical matters that may preclude a meat packing plant from having the freedom of choice.

ORGANIZATION OF THE REPORT

The remainder of the report is divided into six chapters. Chapter II describes the standard depreciation methods and those that have been established for pollution-control facilities. Chapter III examines the costs of different methods of financing pollution-control equipment. Chapter IV relates the financing and tax strategies for equipment to normal company financial strategies. In other words, how do the incentives correspond to a company's maximum cash flow strategy or its profit maximization strategy, and so forth? Chapter V looks at the availability of the various financing alternatives already discussed, both from the Federal Government and from five Midwestern States in which the greatest amount of meat packing takes place. Some financing alternatives are, for practical purposes, always available, while others are dependent upon the source's budget. Chapter VI examines the combination of the first four discussions as opposed to the financial theory of a user charge system. This alternative analysis sets up a basis for decision when the costs of the FWPCA become predictable, an example of which follows in chapter VII.

Chapter II

DEPRECIATION

Many pollution-control acquisition incentives are in the form of special depreciation provisions. Sometimes these provisions are called "rapid amortization," except that the amortization period bears no relation to useful life as in the case of strict depreciation. The underlying effect of any type of depreciation is on the taxes payable by a company and its cash flow. Normally, there exist two general kinds of depreciation incentives for any kind of equipment. One set of depreciation methods provides an annual deduction from income as a noncash expense over a certain guideline period. The timing of deduction selection changes with different depreciation techniques. In other words, large portions of the cost of the equipment can be deducted early in the life of equipment by using one technique, or equal proportions are deductible over the life of the equipment using another technique. This difference in timing gives rise to the familiar terms "straight-line depreciation," "double-declining balance," "sum of the years digits," and so forth.

Another kind of equipment depreciation factor exists for all types of equipment; that is, an incentive actually to buy equipment, called an "investment tax credit" (Secs. 46-48, 50, Internal Revenue Code (IRC)). This provision, in effect, actually reduces the cost of the equipment, because it gives a permanent tax credit. All the different depreciation methods noted previously allow a corporation to adjust its depreciation schedule to conform with its financial management strategies.

To add an incentive for the purchase of pollution-control facilities, the Internal Revenue Service permits a pollution-control facility to be amortized over a period of 60 months (Sec. 169, IRC). Because the 60-month period may have no relationship to the actual life of the equipment, which could be from 120 to 200 months, the incentive is called "rapid amortization."

Depreciation involves consideration of both method and useful life. The ability to take any *method* of depreciation for pollution-control facilities is not precluded because of the method a company customarily uses. The normal requirement for consistent adherence to class-depreciation method is waived. For example, if a packer uses a foods-manufacturing asset-depreciation range (ADR) into which all the assets customarily fall, and he uses the straight-line depreciation method, he could still take double-declining depreciation for the pollution-control equipment.

Another nuance is that when an asset-class-depreciation range is used, a different *useful life* can be used for pollution-control facilities upon sufficient justification. For example, if a packer customarily uses a guideline useful life of 12 years (permitted in the 9.5-14-year ADR), he could use 8 years for the control device if he could substantiate this reduced life. This method may be advantageous if the life of the equipment is less than that of the normal asset range.

RELATIONSHIP OF DEPRECIATION TO TAXES AND CASH FLOW

The financial strategy supporting the rapid amortization plan is a good entry into the methods of analysis for evaluating which depreciation, amortization, and/or investment tax credit method to use. The incentive is that depreciation/amortization is an expense that does not actually involve any cash outlays by the taxpayer. The lower profits from the expense before taxes mean a tax savings. The tax savings is a net cash inflow to the corporation and is represented by

$$NCF = DT$$

where NCF = net cash flow
D = amount of depreciation/amortization
T = the tax rate, expressed as a fraction

Positive cash flows (cash inflows) can be reinvested in the business for the productive side of the operation or to reduce the needs for obtaining cash from other sources. A shortened period of depreciation/amortization means larger deduction, larger tax savings, and more cash flow.

NET PRESENT VALUE

An analysis of this net cash flow through the depreciable life of the equipment will yield a net present value. The total effect of depreciation on a company's cash flow is determined by using the present value approach, which makes use of the time value of money. A dollar saved today has a greater long term effect on the financing situation of an enterprise than a dollar saved a year from now, because the dollar saved today has the potential of yielding a return if invested or saved. Thus, at the end of the year, the future value (FV) of today's dollar is

$$FV = 1 + r$$

where r = yield (interest earned) on $1.

The present value (PV) of the dollar saved a year from now is, on the other hand,

$$PV = \frac{1}{1 + r}$$

The present value of a dollar saved i years from now is obtained by discounting annually

$$PV = \frac{1}{(1 + r)^i}$$

Thus, the present value of the net cash flow during year i, termed discounted cash flow (DCF), is

$$DCF_i = \frac{NCF_i}{(1 + r)^i}$$

The sum total of all such discounted cash flows over the useful life is the net present value (NPV) of the tax savings

$$NPV = \sum_{i=1}^{n} DCF_i = \sum_{i=1}^{n} \frac{NCF_i}{(1 + r)^i}$$

Since NPV is the sum of discounted cash inflows (tax savings), the higher the NPV, the more attractive the depreciation method. The annual discount rate, r, is termed the after-tax return on investment for the enterprise.

For meat packing plants, the cost of capital (the same as the return if funds are reinvested) before tax is estimated to be about 6 percent. After taxes, this figure reduces to about 3 percent. Therefore,

$$r = 3\%$$

The effect of the *NPV*'s from each method of depreciation is to reduce the effective cost of the capital expenditure necessary for the pollution-control facility.

WATER-POLLUTION-CONTROL INVESTMENT FOR MEAT PACKERS

At this time no one can be quite sure what the costs are for the best practicable or the best available control technology for meat packers or any other industry. For illustrative purposes, an average investment figure of $400,000 will be used.

For accounting purposes, the ADR of equipment used in the foods-manufacturing industry, into which category a meat packer usually falls, is 9.5-14.5 years (Sec. 167, IRC). A 12-year life will be used, based on the guideline useful life of the ADR. Salvage value is assumed to be zero.

Rapid Amortization

The Tax Reform Act of 1969 provides for rapid amortization of certified pollution-control facilities over a 60-month period, irrespective of the guideline useful life of the equipment. This amortization is available under certain conditions outlined in Article 169 of the Internal Revenue Code. The accelerated writeoff was provided to encourage capital investment in pollution control. Note that a process change, even if it results in lower pollution, does not qualify as a pollution-control device, and such costs cannot be rapidly amortized.

The rapid amortization applies to the first 15 years of life of the equipment. The asset portion value over 15 years can be depreciated by any method under article 167 and depreciation can be taken immediately on that portion. The rapid amortization can begin in the month after installation and continue for a full 60 months, or it can begin in the next fiscal year. For the intervening months until the next fiscal year begins, a traditional depreciation method can be used.

An additional first-year depreciation (Sec. 179, IRC) amount of 20 percent of a maximum asset value of $10,000, or a maximum deduction of $2,000, can be taken in the first year of an asset purchase. The "bonus" first year depreciation can be taken if a taxpayer elects to take the rapid amortization or any other method of depreciation. Although this provision is not considered a pollution-control incentive, its inclusion is needed for accuracy of calculations.

For purposes of simplification, it will be assumed that the effective date of purchase of the $400,000 waste-treatment facility is the beginning of the fiscal year and that the corporate income tax rate is 48 percent. Computation of the net present value of the $400,000 investment using rapid amortization results in

$$\text{Yearly cash flow} = T\,D$$

$$= (0.48)(\$80{,}000)$$

$$NPV = \sum_{i=1}^{n} DCF_i$$

$$DCF = \frac{NCF_i}{(1 + r)^i} \qquad r = 3\%$$

$$NPV = \$175{,}918$$

Straight-Line Depreciation

The base or most simple form of depreciation involves taking an equal proportion of 8 1/3 percent for each year of the 12-year life of the depreciable base under the appropriate foods-manufacturing depreciation class. In this case, the depreciable base could have been reduced to \$398,000 by taking the additional first-year bonus depreciation of \$2,000 (maximum), but the point of emphasis is to have the straight-line method serve as a base. Using the foregoing formula *with the \$400,000 base, the NPV of cash inflows is \$159,266.*

Investment Tax Credit

The Internal Revenue Code (Secs. 46-48, 50) allows an investment tax credit of 7 percent of the equipment cost to be applied to the reduction of corporate income taxes payable. Investment tax credit is a special incentive for the business community to purchase capital equipment. This tax credit is a full and direct tax savings of \$28,000 in this example. This figure, adjusted by the *NPV*, should be added to the straight-line depreciation *NPV*, since the investment tax credit is allowed for that method. The resulting *NPV* is \$186,596. This calculation also takes into account the *NPV* of the after-tax additional first-year depreciation. There is a special caution on investment tax credit. Rapid amortization and investment tax credit are mutually exclusive; a choice between the two must be made at the outset.

There are many other details of these amortization and tax credits laws that are too detailed or peripheral to present here, and that do not change the essence of the calculations.

Double-Declining Balance Depreciation

The double-declining balance method is the quickest method allowable, except for the aforementioned special rapid amortization of depreciating equipment through its useful life. The calculation provides that, in each year, 20 percent of the remaining asset balance can be deducted. In the example case, the first year's depreciation is \$81,600 (0.2 × \$398,000 = \$79,600 + \$2,000). In the second year, the 20 percent is taken against \$398,000 – \$79,600, or \$318,400, resulting in a figure of \$63,680.

When year-by-year cash flows are discounted using the rate of return, the *NPV* for the \$400,000 equipment, using double-declining depreciation, becomes \$203,000.

There is, of course, another depreciation method, sum of the years digits, that has results between the straight-line and double-declining methods.

Net Present Value Calculation

Mathematically, table II-1 below shows how the *NPV* is calculated for a \$400,000 piece of equipment depreciated by the straight-line depreciation method over 12 years. The effect of the investment tax credit plus the additional first year's depreciation is also considered.

Table II-1.—*Example of* NPV *calculation for straight-line depreciation*

End of year	Depreciable base	Rate depreciation	After tax depreciation	Rate of discount	*NPV*
	Dollars	*Percent*	*Dollars*		*Dollars*
1	[1]400,000	Maximum	960	1.03	[2]928
1	398,000	8 1/3	15,920	1.03	15,456
2	398,000	8 1/3	15,920	1.0609	15,006
3	398,000	8 1/3	15,920	1.0927	14,569
4	398,000	8 1/3	15,920	1.1255	14,145
5	398,000	8 1/3	15,920	1.1592	13,734
6	398,000	8 1/3	15,920	1.1940	13,333
7	398,000	8 1/3	15,920	1.2298	12,945
8	398,000	8 1/3	15,920	1.2667	12,568
9	398,000	8 1/3	15,920	1.3047	12,202
10	398,000	8 1/3	15,920	1.3438	11,847
11	398,000	8 1/3	15,920	1.3841	11,502
12	398,000	8 1/3	15,920	1.4256	11,167
					159,402
7 percent investment tax credit discounted back to year zero					27,184
Total *NPV*					186,586

[1]The $2,000 maximum additional first year's depreciation must reduce the succeeding year's depreciable base by the same amount.
[2]Additional first year's depreciation.

Depreciation Comparisons

Figure II-1 shows the relationship of the value of each depreciation method to the overall cost of the equipment. The values are less than the base cost because of the cost-offsetting earnings from the cash generated by the tax savings from depreciation.

Limiting the consideration to net present value, the optimal strategy in the example case is the double-declining balance method accompanied by the investment tax credit and additional first year's depreciation. The fact that this form of depreciation is favored over the special pollution-control rapid amortization makes one question how the situation arises. When the rapid amortization provision was enacted into law, the investment tax credit, which is historically an on-and-off type of tax incentive, was not in effect. Later the investment tax credit became effective for equipment installed after March 1971. Economic resurgence was the major consideration when the investment tax credit was reinstated, and not how it would relate to the rapid amortization method.

The investment tax credit plus double-declining preference is accentuated first by the fact that process changes made to comply with pollution-control regulations do not meet requirements for rapid amortization (only control devices do), and second by the fact that the investment credit, per se, never needs to be repaid, whereas rapid amortization really represents only a postponement of taxes.

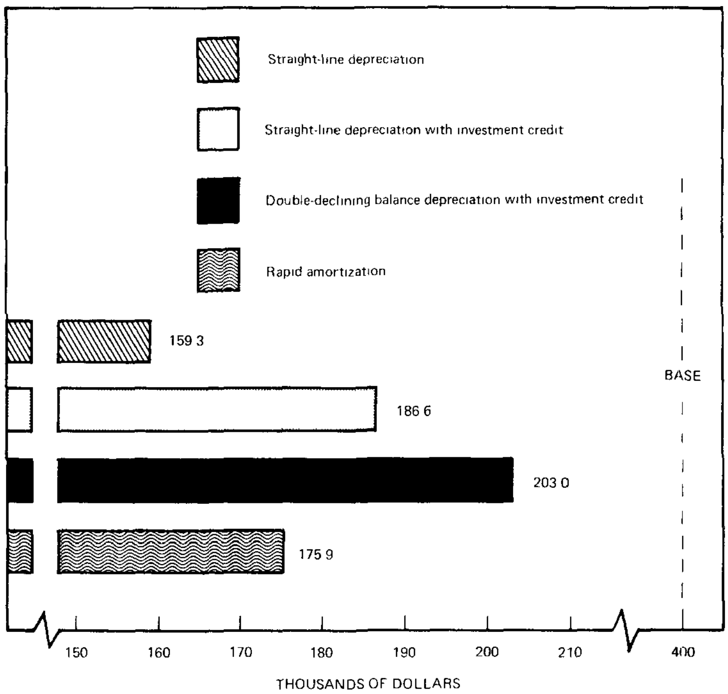

Figure II-1. Net present value of tax savings through depreciation.

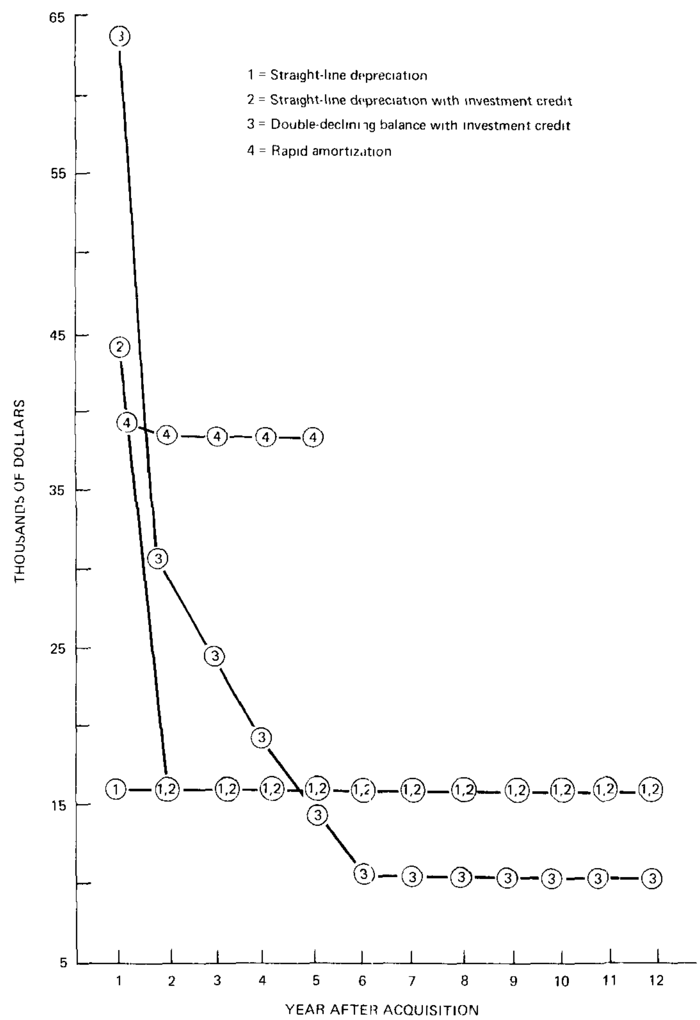

Figure II-2. Year-by-year savings (cash flow improvements) through different tax strategies.

Figure II-2 shows the year-by-year after-tax positive cash flows from the various depreciation alternatives. The difference between the 1's and 2's is the additional tax investment credit and additional first-year bonus depreciation taken in the first year of the 2's.

The rapid amortization plan cash flows 4's are practically level because of the installation of the equipment at the beginning of the fiscal year. The slight hump in the beginning results from the additional first year's depreciation. A midyear installation with an election to begin the 60-month amortization period the next fiscal year would have resulted, under optimal conditions, in a higher hump in the first year also, with a level amount over the next 5 years at a very slightly lower level.

The large hump in the first year of the double-declining balance method, shown by 3's, results from taking the investment tax credit and the additional first year's depreciation.

Ability to Use Investment Tax Credit

A company must have a sufficient level of pretax earnings to be able to make full use of the investment tax credit. An investment tax credit greater than the amount of corporate income taxes payable would defeat some of the advantage of taking the investment tax credit. Not in this example, but in actuality, a company has to earn $71,875 before taxes to use the $28,000 available investment tax credit. This calculation used the corporate tax rates of 22 percent of all income and 26 percent of income over $25,000.

It is true that unused investment tax credits can be carried over into the future under certain conditions (Sec. 46B, IRC); however, the net present value of an investment tax credit carryover reduces, and its calculation here would present an unnecessarily complex situation.

SUMMARY

This chapter demonstrated the large magnitude of differences in net present values (*NPV*'s) by using the various depreciation methods. The purpose of using *NPV* was to have a common standard of analysis by which the available depreciation methods for pollution-control facilities could be compared. The example used for calculations showed the advantage of the double-declining balance method with investment tax credit over all other methods including rapid amortization. The life of the equipment has to be very long (over 30 years) before another depreciation method becomes superior in this illustration.

The next chapter will look at the effect of the special incentives for financing pollution-control equipment. The determination of the differences in values for these financing methods, coupled with the analysis just performed, will carry into chapter IV, where the tax and financing strategies are combined.

Chapter III

FINANCING STRATEGIES FOR POLLUTION-CONTROL INVESTMENTS

Before any special pollution-control legislation, a plant manager would make the decision about a piece of equipment and then, if money was to be borrowed to pay for the equipment, get in touch with his normal financing source and request arrangements. With the advent of special pollution-control incentives there are, in general, not only new sources of funds available, but lower rates than normal for most sources of financing. This situation requires another whole set of analyses before the best source of funds can be chosen.

Generally, two aspects of the financing strategy are covered in this chapter. The first aspect is the quantitative analysis using *NPV* as a tool for valuing each financial source and rate. The second aspect describes each financial source and, based on rate and terms, calculates and compares the *NPV* of each. As in chapter II, the example is based on a $400,000 waste-treatment system.

METHODS USED IN ANALYZING FINANCING COSTS

In order to determine the cost to the company of the various available methods of raising funds, it is necessary to analyze the effect of fund raising on the company's operating financial position—its net profits after taxes. The methodology used in the subsequent comparisons is described below.

A comparison of the after-tax profits with and without the financing for pollution-control equipment makes it possible to quantify and analyze such an effect. Net annual profit after taxes, P, and the tax liability, L, can be related to other operating parameters by the equation

$$P = p(1 - T) \qquad L = pT$$

where p = annual taxable income
T = the tax rate, expressed as a fraction

The annual taxable income is related to the interest expense for the year by

$$p = Q - I$$

where Q = the operating income
I = the interest expense

Combining the preceding two equations,

$$P = (Q - I)(I - T) \qquad L = (Q - I)T$$

$$= Q(1 - T) - I(1 - T) \qquad = QT - IT$$

If there was no interest expense during the year, $I = 0$, and the foregoing equations become

$$P = Q(1 - T) \qquad L = Q\,T$$

Thus, the effect of the interest expense, I, is to reduce the net profit after taxes by $I(1 - T)$. The tax liability is reduced by $I\,T$.

If C is the amount of principal paid back during a year, and I the interest expense incurred as a result of the loan, the net cash outflow, NCF, is the net of cash outflows and the reduced tax liability (or tax savings).

$$NCF = (C + I) - (I\,T)$$

$$= C + I(1 - T)$$

This equation represents the net effect of the loan on the company's cash balance during a year. (It must be kept in mind that, in this analysis, the *operating costs* resulting from the control equipment are not considered. The effect of *initial investments* in pollution control on the company's fiscal position is analyzed here.)

The payment of interest and principal payback extends through the term of the loan, which is defined as more than 1 year for a long term loan. The net cash outflow, NCF_i during year i, is given by:

$$NCF_i = C_i + I_i(1 - T) \qquad i = 1, 2, \ldots, n$$

where C_i = principal payback during year i
I_i = interest expense during year i
n = term of the loan in years

The total effect of the loan on the company's cash flow is determined by using the present value approach, which uses the concept of time value of money, described in chapter II.

Thus, the discounted cash flow during year i,

$$DCF_i = \frac{NCF_i}{(1 + r)^i}$$

The sum total of all such discounted cash flows over the terms of the loan is the net present value, NPV, of the loan.

$$NPV = \sum_{i=1}^{n} DCF_i = \sum_{i=1}^{n} \frac{NCF_i}{(1 + r)^i}$$

Since NPV is the sum of discounted outflows, the lower the NPV, the more attractive the loan. The annual discount rate, as in chapter II, is the after-tax cost of capital for the meat packer; $r = 3$ percent. For domestic corporations, the normal Federal tax rate amounts to 22 percent on taxable income, plus a 26-percent surtax on income over $25,000. A tax rate of $T = 48$ percent is assumed throughout this analysis.

BANK FINANCING

Some commercial banks across the country have announced preferential rates and terms for certified pollution-control facilities. Since these bank programs are quite random, the basis of analysis used here for financing pollution-control equipment will be the type of normal equipment borrowing, and not a special bank control loan.

The terms and rate suggested here as normal for this type of financing are 5 years and 6 percent annually, with the effective rate of interest being 11.08 annually. The *NPV* analysis for financing the $400,000 packing-treatment system through a bank is $422,353. The cash flows for this financing alternative are unique because of the bank repayments system. Although the repayment amounts are the same, the proportion of interest in those repayments is higher in the beginning. This interest is tax deductible; therefore, the net cash outflow is approximately halved. Because the repayments are equal, and the proportions of the earlier payments have more tax-deductible interest expense and lower principal repayments, the net cash outflow is lower in the beginning.

SMALL BUSINESS ADMINISTRATION–WATER POLLUTION CONTROL LOANS

Because it could occur that some meat packers might have access to the funds legislated under the Federal Water Pollution Control Act, the cost of such an alternative will be analyzed. Since this fund was just recently legislated and is as yet unappropriated, there are many program details yet to be developed. The fund, however, will be administered through the Small Business Administration (SBA), and will most likely bear a rate equal to the weighted average of all Federal Government borrowings. At present that rate is 5 3/8 percent, and with general interest increasing 5.5 percent has been used here.

According to the FWPCA, those who qualify for the SBA loans are "any small business concern *in affecting additions to or alterations in the equipment, facilities* (including the construction of pre-treatment facilities and interceptor sewers) or methods of operation of such concern to meet water pollution control requirement . . . if such concern is likely to suffer substantial economic injury without assistance."

Obviously precarious is any attempt to determine how many companies in the meat packing industry will sustain substantial economic injury without assistance.

SBA loans are permissible to 30 years; however, a 10-year loan term has been chosen to recognize the guideline useful life of the ADR in which meat packing belongs. Using the 5.5-percent rate and the 10-year repayment schedule, the *NPV calculates to $397,272.*

GOVERNMENT AID TO FINANCING (TAX FREE)

As a result of the effort to encourage industrial development in general, and in some cases to encourage industry to install control equipment on sources of pollution, governmental aid is available in the following areas:

- Aids to individual borrowers for low-cost capital
- Tax aids to industry through special regulations and procedures

The consequences of the latter aids will not be described at length, as their impact is not large and varies from State to State. These aids include sales, use, and property tax exemptions.

Many States now have financing programs for the purchase and installation of pollution-control facilities. These States, via governmental and quasi-governmental agencies, assist in floating attractive low-interest bond issues and in raising the required funds through industrial mortgages. Such bonds bear a lower interest rate than any of the aforementioned methods, because the interest payments are presently free of Federal and State income taxes.

The terms in this example include a 5-percent interest rate, with an initial underwriting cost of 5 percent. The repayment period is 15 years and the repayment schedule is as follows: 8 percent of principal annually during years 5-14, and the remaining 20 percent of the principal during year 15.

A word of caution about tax-free status—it is prudent to obtain the advice of counsel. A whole set of provisions exists on the nature of the facilities qualifying and certified as eligible for tax-exempt financing.

The *NPV* of cash outflows for the tax-free financing method for the terms described, and in our $400,000 example, is $389,137.

Table III-1 is an example of how *NPV* would be calculated for a 5-year bank loan for $400,000 (see also ch. II). The rate of interest is stated at 6 percent and the loan is repaid quarterly.

Table III-1.—*Example of* NPV *calculation for bank financing*

Year	Repayment interest portion	Principal repayment	Yearly repayment	Interest x $(1 - T)$	Plus principal	Discount factor	*NPV*
1	$ 42,286	$ 61,714	$104,000	$21,989	$ 83,703	1.031	$ 81,265
2	33,143	70,857	104,000	17,234	88,091	1.0609	83,034
3	24,000	80,000	104,000	12,480	92,480	1.0927	84,634
4	14,857	89,143	104,000	7,726	96,869	1.1255	86,068
5	5,714	98,286	104,000	2,971	101,257	1.1592	87,352
Total, 5 years	120,000	400,000	520,000				
Total *NPV*							422,353

Note.—Interest rate, 6 percent; loan repaid quarterly.

COMPARISON OF FINANCING METHODS

Figure III-1 shows the net present values of the negative cash outflows in financing the $400,000 cost by the three alternatives. This set of alternatives actually represents a range of maximum and minimum financial costs into which fall all methods of financing. In other words, more alternatives exist, but the results would fall between the highest and the lowest bar.

The figure clearly shows the superiority of the tax-free method of financing pollution-control equipment under net present value considerations. Equally important in emphasis is the magnitude of the range of values. On a $400,000 piece of equipment alone, the range is approximately $33,000—a substantial cost if all the financing possibilities had not been fully considered.

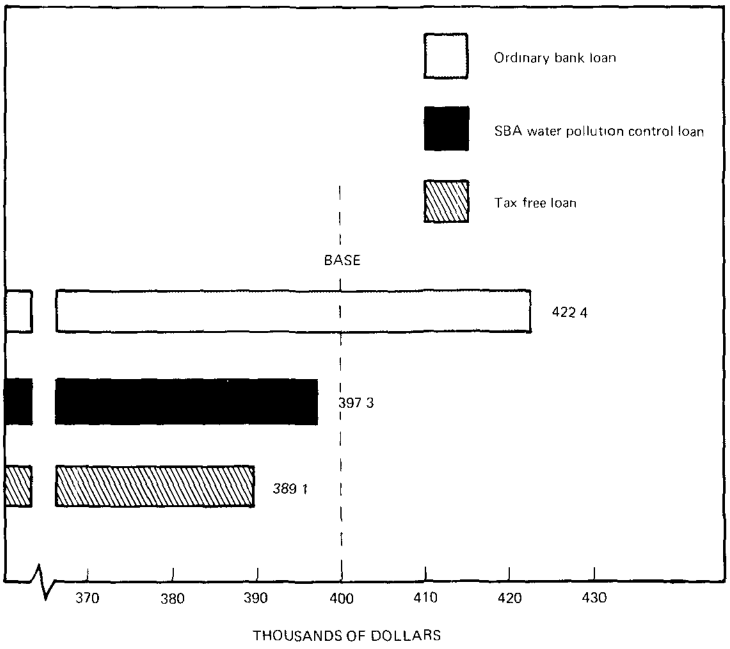

Figure III-1. Net present values of cash outflows from financing.

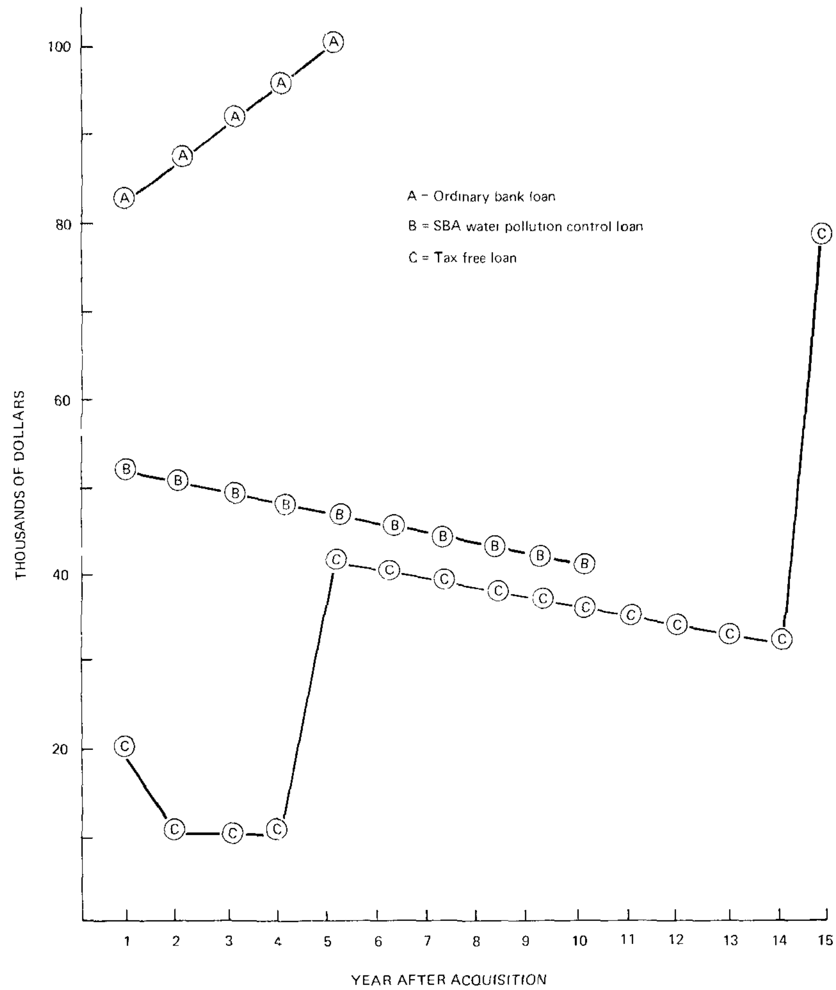

Figure III-2. Year-by-year cash outflow from different financing strategies.

Figure III-2 shows the great differences in year-by-year cash outflow that result from the three financing strategies. The conventional bank loan, for example, leads to much higher outflow during the first 5 years than either of the other strategies. On the other hand, a bond issue has the lowest cash outflow for an extended period. Depending on the payoff method chosen, however, full repayment of principal at the end or a sinking fund will be required. In the case of the tax-free loan (bond), high cash outflow is generated owing to the ballooning effect in the final year.

SUMMARY

Now that the ranges of financing and tax strategies have been described and analyzed fully, the choices for selection purposes may be related. In order to perform selection, the objectives by which companies are managed will be explained in chapter IV as they impact possible combinations of the tax and financing alternatives.

Chapter IV

DEVELOPING THE OPTIMUM FINANCIAL STRATEGY

With the data now available from the calculations discussed in chapters II and III, it is now possible to develop the appropriate management approach to financing and tax strategies. The idea is to select the right combination of strategies to meet the management objectives of the company. To illustrate the pronounced effects involved, a hypothetical plant procurement will be used.

Table IV-1 contains the key characteristics of three financing strategies, as well as fiscal characteristics of the hypothetical pollution-control equipment needed. This table will be used as the common base in developing the three illustrative examples that follow.

Table IV-1.—*Illustrative financial characteristics of pollution-control equipment for the meat packing industry*

Equipment characteristics:	
Investment cost	$400,000
Salvage value	0
Useful life	12 years
Tax status:	
Corporate income tax rate	48 percent
Investment credit	7 percent subject to a certain maximum
Additional first year's depreciation	$2,000
Effective cost-of-capital rate	3 percent annually
Financing terms:	
Ordinary bank loan:	
Stated interest rate	6 percent annually
Effective interest rate	11.08 percent annually
Repayment period	5 years
SBA-Water Pollution Control Loan:	
Interest rate	Weighted average Treasury rate
Present Treasury rate	5 3/8 percent ~ 5.5 percent
Payment period	As long as 30 years, not more than life of equipment, 10 years
Tax-free loan:	
Interest rate	5 percent
Initial cost of obtaining loan	5 percent of capital
Repayment period	15 years
Repayment schedule	8 percent of principal annually during years 5-14, 20 percent of principal during year 15 (balloon)

Table IV-2.—*Example of* NPV *calculations for combined cash inflows and outflows*
[Dollars]

Year	*NPV* of year-by-year cash inflows	*NPV* of year-by-year cash outflows
1	43,568	81,265
2	15,006	83,034
3	14,569	84,634
4	14,145	86,068
5	13,734	87,352
6	13,333	
7	12,945	
8	12,568	
9	12,202	
10	11,847	
11	11,502	
12	11,167	
Total	186,586	422,353
Less *NPV* cash inflows		186,586
Total *NPV*		235,767

No two meat packers face the same financial problems. And no two share exactly the same management objectives. To demonstrate the cumulative effects of the various tax and financing strategies covered so far, three typical business situations have been selected, involving different management objectives that might exist in a meat packing operation. How different strategy combinations affect each situation will be shown.

Table IV-2 gives the calculations for another simplified example. The objective is to show how the *NPV* of the combination of tax and financing strategies was obtained. As will be seen later, the term *NPV* becomes synonymous with the lowest long term profit impairment a project has on a company. The figures used are those developed in chapters II and III for a $400,000 capital investment. Note that the equipment was depreciated in 12 years and financed in 5 years.

First, a look at a meat packer with a weak working capital. He needs pollution-control equipment, but cannot "afford" it, now or in the foreseeable future. Clearly, the situation calls for the lowest possible cash outflow, year by year, over the life of the investment.

The lowest cash outflow, and the strategy combinations that permit it, are shown in table IV-3. This value, shown boxed, is $35,300—the result of following a combination of tax strategy 2 and financing strategy B. It is the best choice for a meat packer with weak working capital acquiring pollution-control equipment.

Using a 3-year period as the near term, table IV-4 shows the cumulative profit impacts of the different strategies in their various possible combinations, resulting in the best near term profit. The boxed value, $51,900, represents the lowest possible cash outflow under the circumstances. It is derived from a combination of strategies 2 and B.

Finally, there is the meat packer with enough resources and stability to concentrate on maximizing his long-term profit. Table IV-5 shows that the strategies producing the lowest long term

Table IV-3.—*Comparisons of peak annual cash drain from different tax and financing strategies*
[Dollars]

Tax strategy	Financing strategy		
	A. Conventional bank loan	B. SBA-Water Pollution Control Loan	C. Tax-free loan
1. Straight-line depreciation	87,500 (5)	35,900 (1)	52,200 (15)
2. Straight-line depreciation with investment credit[1]	87,500 (5)	35,300 (2)	52,200 (15)
3. Double-declining-balance depreciation with investment credit[1]	87,800 (5)	36,400 (6)	52,200 (15)
4. Special amortization for pollution-control equipment[1]	68,300 (5)	45,700 (6)	52,200 (15)

[1] Also includes effect of additional first year's depreciation (Sec. 179, Internal Revenue Code).

Note.—Useful life = 12 years; investment cost = $400,000. Figures in parentheses indicate year after acquisition during which stated peak cash drain is reached.

Table IV-4.—*Comparisons of short term profit impairment from different tax and financing strategies*
[Dollars]

Tax strategy	Financing strategy		
	A. Conventional bank loan	B. SBA-Water Pollution Control Loan	C. Tax-free loan
1. Straight-line depreciation	98,000	78,200	·88,500
2. Straight-line depreciation with investment credit[1]	71,700	51,900	62,200
3. Double-declining balance depreciation with investment credit[1]	90,600	70,800	81,100
4. Special amortization for pollution-control equipment[1]	168,000	148,200	158,500

[1] Also includes effect of additional first year's depreciation (Sec. 179, Internal Revenue Code).

Note.—Useful life = 12 years; investment cost = $400,000.

profit impairment ($186,100) are double-declining-balance depreciation with investment credit combined with a tax-free loan (strategies 3 and C).

The hypothetical examples of tables IV-3 to IV-5 do not represent straightforward totals of year-by-year values, but rather the totals of present values, attributable at the start of the period to the future events portrayed in the examples. This replacement is necessary because a meaningful comparison between financial effects occurring at varying times in the future can be obtained only by relating them all to a common point in time, such as the present.

Table IV-5.—*Comparison of long term profit impairment from different tax and financing strategies*
[Dollars]

Tax strategy	Financing strategy: A. Conventional bank loan	Financing strategy: B. SBA-Water Pollution Control Loan	Financing strategy: C. Tax-free loan
1. Straight-line depreciation	263,100	238,000	229,900
2. Straight-line depreciation with investment credit[1]	235,800	210,700	202,500
3. Double-declining balance depreciation with investment credit[1]	219,400	194,300	186,100
4. Special amortization for pollution-control equipment[1]	246,400	221,400	213,200

[1] Also includes effect of additional first year's depreciation (Sec. 179, Internal Revenue Code).
Note.—Useful life = 12 years; investment cost = $400,000.

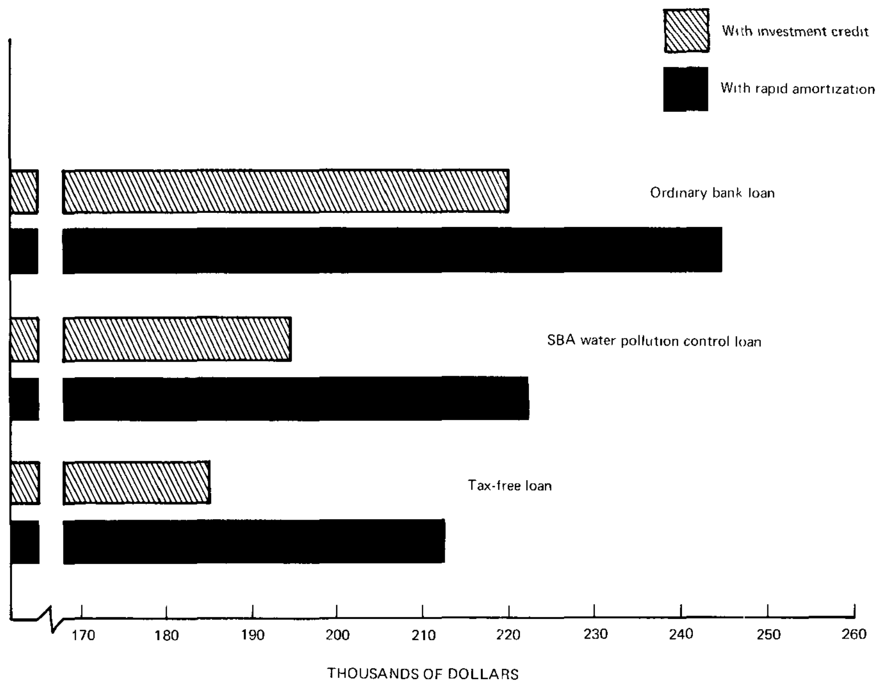

Figure IV-1. Long term profit impairment from various financing and tax alternatives.

Having chosen a combination of tax and financing strategies based on analyses such as those presented in tables IV-3 to IV-5, it is good practice to refer to separate year-by-year projections like those in figures II-2 and III-2. Doing so determines year-by-year effects and makes them fall within acceptable limits.

In all three cases discussed, the rapid amortization plan for pollution-control equipment was not the optimal choice. By the very fact that tax incentive exists it is logical to be drawn to its use.

As demonstrated, however, the management objective carries the deciding weight in determining whether or not rapid amortization is the optimal choice.

Figure IV-1 clearly demonstrates why all this analysis is so important. From the consideration of long term profit impairment, the magnitude of the difference in costs to a company is the height of the difference in the maximum and minimum costs. If a pollution-control facility in the example were financed by an ordinary bank loan and rapid amortization were taken (a fairly traditional choice), the effective cost would have been $246,400. A tax-free loan and investment tax credit with double-declining balance depreciation results in an effective cost of $186,100, a savings over the former plan of $60,300. It is well worth devoting whatever cost is necessary to explore the various alternatives available to arrive at the optimal choice.

To determine how optimal the choice can be for an equipment investment, chapter V will explore the degree of availability for all of these alternatives. Limitations in the availability may possibly reduce the optimum savings; however, the savings will still be substantial.

Chapter V

STATE FINANCING AND TAX INCENTIVES

The tax and financing strategies discussed in chapters II and III and the simplified examples of how they relate to management objectives (ch. IV) were based on an assumption that all companies would have access to each alternative. Whether this assumption holds true for a company depends considerably on size and location. The depreciation methods for tax strategies are available for any size company in any location.

Financial strategy availability is a much more complex matter requiring expert legal and tax advice. For example, although the tax-exempt financing is generally more attractive than regular bank borrowing, smaller companies generally do not have access to this source throughout the United States, except for a very few States.

A general statement cannot be made concerning tax-free financing that conveys obvious advantages to the borrower because of the many variations from State to State, but generally the borrower must qualify for the credit from either the public or a private source of capital. Enabling legislation also must have been passed in the State to permit revenue bond-industrial development financing for pollution-control facilities. The ultimate tax-free eligibility ruler is the Internal Revenue Service (IRS). Specific attention therefore must be paid to what each meat packer's State has passed into law regarding availability of antipollution revenue bonds.

Size also is an important factor because there is usually a fixed portion of any bond-underwriting expense. Thus, a bond issue must be large enough to make those initial fixed costs effectively minimal. This limitation cuts off many potential users, or requires that a State have a form of private placement system for loans of less than nominally a million dollars.

The possible financing via States varies widely, as can be seen from table V-1. The tax regulations are usually fairly lengthy and considerably involved, so that they generally defy any attempt to condense and simplify. They are also time varying, and the reader is cautioned to obtain a current reading before selecting a course of action.

The foregoing relates to the alternative involving equipment purchases; also of concern are State and Federal programs for financing the municipal treatment plants into which individual companies connect themselves. As for the Federal portion of construction grants, the monies contained in the 1972 Federal Water Pollution Control Act (FWPCA) were based on a survey of municipal areas planning to upgrade. Thus, the authorization was designed to satisfy all plants. The municipalities then in question, however, were not necessarily relating their estimates to secondary treatment, defined as best practicable, nor to any advanced treatment. A new survey will be taken to determine just how suitable was the FWPCA authorization. Presumably, construction grant money over time will be available for the vast majority of plants. A major appeal of this money is that interest is not included in any repayments.

Of a quite varying nature will be the cost and source of the monies to finance the remaining minimum 25 percent. Further complicating the situation is the degree to which these funds have to be repaid. Obviously, if a bond issue is floated to raise the local portion, the full cost plus interest

Table V-1.—*Financial assistance and tax incentives for industry*

State	1	2	3	4	5	6	7	8	9	10
Alabama	X	X	X	X		X	X	X	X	
Alaska	X	X	X	X	X	X	X	X	X	
Arizona	X		X	X						
Arkansas	X	X	X	X					X	
California		X							X	
Colorado	X	X	X	X						
Connecticut	X	X	X		X				X	
Delaware	X		X					X	X	
Florida	X	X	X	X						
Georgia	X		X	X					X	X
Hawaii	X		X	X	X	X		X	X	X
Idaho									X	
Illinois	X	X	X	X						
Indiana	X		X	X				X	X	
Iowa	X	X	X	X						
Kansas	X	X	X	X			X	X		
Kentucky	X	X	X	X	X		X	X	X	
Louisiana	X		X	X	X		X	X		
Maine	X	X	X	X					X	
Maryland	X	X	X	X			X	X	X	
Massachusetts	X	X	X	X				X		
Michigan	X		X	X				X	X	X
Minnesota	X	X	X	X	X		X	X		
Mississippi	X	X	X	X			X	X		
Missouri	X	X	X	X			X	X	X	
Montana	X	X	X	X			X	X		
Nebraska	X	X	X	X						
Nevada	X		X	X						
New Hampshire	X	X	X						X	
New Jersey	X	X								X
New Mexico				X		X				
New York	X	X	X	X	X		X	X	X	X
North Carolina		X							X	
North Dakota	X	X	X	X		X	X	X		
Ohio	X	X	X	X					X	X
Oklahoma	X		X	X	X				X	
Oregon	X	X	X				X			
Pennsylvania	X	X	X	X		X		X	X	X
Rhode Island	X	X	X	X			X	X		X
South Carolina	X	X	X	X			X	X	X	
South Dakota	X		X	X		X				
Tennessee	X	X	X	X			X	X	X	X
Texas	X		X	X			X			
Utah	X	X	X	X						
Vermont	X	X	X	X						X
Virginia	X	X	X	X					X	
Washington	X	X	X	X						
West Virginia	X	X	X	X	X	X			X	
Wisconsin	X		X	X					X	
Wyoming	X	X	X	X		X				

Note.—1 = State-sponsored industrial development authority. 2 = privately sponsored development credit corporation. 3 = State authority or agency revenue bond financing. 4 = city and/or county revenue bond financing. 5 = State loans for equipment, machinery. 6 = excise tax exemption. 7 = tax exemption or moratorium on land, capital improvements. 8 = tax exemption or moratorium on equipment, machinery. 9 = sales-use tax exemption on new equipment. 10 = sales-use tax exemption applicable to lease of pollution-control facilities.

requires repayment. Funds appropriated from a State public works budget will have different repayment schemes and degrees, depending on the State.

There follows a brief and simplified overview of several States that are expected to be of special interest to meat packers.

According to statistics from the last *Census of Manufacturers,*[1] the following States had the highest value of shipments:

- Iowa, $2,497.7 million
- Nebraska, $1,382.9 million
- Minnesota, $1,119.6 million
- California, $1,116.1 million
- Texas, $732.8 million
- Illinois, $726.4 million
- Ohio, $692.6 million
- Missouri, $682.4 million
- Kansas, $601.3 million

The total for these nine States is $9.552 billion, or 63 percent of the 1967 sales for the entire meat packing industry, $15.248 billion. Five of these States germane to the immediate audience of this report will be selected to alert the meat packers about provisions in their States. The volume for these five States represents well over one-third that of the entire industry. Therefore, the legislation of Iowa, Nebraska, Illinois, Missouri, and Kansas has a very important financial as well as technical impact on pollution-control efforts of the meat packing industry.

There are two categories of State tax incentives, as mentioned before. One category comprises exemptions from certain State taxes whose consideration would not enter the calculations performed in previous chapters. Examples include franchise taxes, property taxes, use taxes, and sales taxes. Equipment purchases in the States with these kinds of incentives are straightforward in the sense that a purchaser receives those benefits or he does not. There are no other alternatives to analyze. The second category pertains to the cost of financing involving low-cost pollution-control loans.

IOWA

The State legislature of Iowa has not yet provided any pollution-control incentives that permit exemptions or special deductions from any form of taxation. The tax-free status, as mentioned earlier, is not for any State legislature to grant, since that privilege belongs to the IRS. Iowa does have the legislation for allowing pollution-control facilities to be financed with industrial development bonds.

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[1] U.S. Department of Commerce, Bureau of the Census, Washington, D.C., 1967.

Under the Iowa Department of Environmental Quality Act, there are provisions for the State to fund up to 50 percent of the portion of a municipal water-pollution-control construction project, but at least 25 percent of total cost of construction. The fund is called the "sewage works construction fund." The projects that qualify are also those that qualify for Federal construction grants under the FWPCA.

ILLINOIS

Under the Revenue Act of 1939 (Rev. Stat., chs. 120, 482 et seq.) of Illinois, certified pollution-control facilities are exempt from real and personal property taxes. The assessment of property on which the real or personal property tax is levied takes into account the economic value of productivity to the owner, which for pollution-control facilities is little, if anything, unless costs are partially recovered.

Also, under the Illinois Retailers' Occupation Tax, Article 2, Section 6, sales of pollution-control equipment are exempt from the sales tax. Certification need not be acquired for this exemption.

As with Iowa and the States to follow, Illinois also permits pollution-control facilities to be financed via industrial development bonds.

MISSOURI

The State of Missouri provides a sales and use tax exemption for pollution-control facilities under section 144.030 (13) and (14) of the appropriate law.

A general property tax exemption for pollution-control equipment is not provided by legislation; however, control equipment financed by industrial development bonds is actually municipally owned, and consequently requires no property tax.

In a few States, and Missouri is one, the specific enabling legislation for pollution-control financing via industrial development bonds has not been passed. Interpretations of the existing legislation have been sufficient, however, to allow this method of financing.

Under various chapters of the Missouri Water Pollution Law, grants can be made for municipal treatment works. The State can grant up to 25 percent of the construction cost for projects that also qualify for Federal aid (ch. 204.210). Also, chapter 204.230 indicates that the Missouri Water Pollution Board's "determination of relative need, priority of projects, and standards of construction shall be consistent with the FWPCA." This same chapter also requires a cost recovery system from the users, whereby all costs are recovered including interest, depreciation for future replacement, and maintenance and operation.

KANSAS AND NEBRASKA

Records of J.A. Commins & Associates, Inc., indicate that Kansas and Nebraska do not have tax-exemption programs for pollution control. These States do have industrial development bond programs through which tax-free loans are used for pollution-control financing.

The foregoing description of incentives in various States should strongly demonstrate two aspects.

- It would be unusual to find the exact same condition in two States, especially where the incentive legislation is time varying.
- It is worth the effort to study the tax and financing schemes available in the pertinent State.

REVIEW

From the preceding explanation, it becomes clear that the ability to achieve an optimum financial strategy is highly dependent upon the size of the firm and its location. Parameters used in chapters III and IV in the optimal choice analysis may have to be altered to reflect a firm's real spectrum of choices. The stress in the analysis thus far has been a firm's capital costs. In the next chapter, the realm of user charges and their possible modifications in the future will be discussed. Complete optimization under long-range management objectives then can be made by weighing the ramifications of being a part of a municipal wastewater-treatment system versus constructing private treatment facilities.

Chapter VI

FINANCIAL DECISIONMAKING THEORY FOR MUNICIPAL VERSUS PRIVATE FACILITIES

Assuming that each alternative is available, many meat packing plants have the ability to choose whether they should have private or municipal wastewater treatment. The present mix of meat packing plants, as stated in the foreword, favors municipal tie-ins. Such a mix is not unexpected considering the fact that user charges generally have not been assessed based on any cost-accounting system for allocating the entire costs of operations and replacements. Likewise, many rural and developing areas over the years have been able to attract plant locations by purposely keeping user charges low.

This user charge system, as we know it today, is headed for abrupt change due to the 1972 Federal Water Pollution Control Act (FWPCA) amendments. As generally known, all wastewater control standards for private and public wastewater treatment will become highly stringent as a result of the aforementioned legislation. Unless existing private or public plants happen to have advanced wastewater treatment, all will be expected to make significant investments in the best practicable or best available technology.

It is fairly safe to say that a major decisionmaking process in water-pollution control will take place in the United States owing to the large number of companies expected to need change. A major part of the decisionmaking scope includes the financial implications of equipment buying versus yearly municipal waste-treatment rates.

Under previous amendments to the FWPCA there has always been a grant system, although comparatively small, through which Federal funds were apportioned to the States. The 1972 FWPCA amendments continue the grant concept, but at a tremendously bolstered dollar level. The fraction of total municipal treatment construction costs that can be funded by the Federal grants has also been increased. At least $21 billion in future and repayment construction grants eventually will be funneled to municipalities; provisions of the FWPCA will permit up to 75 percent of the construction costs to be derived from the Federal grant.

It also appears that a significantly higher user charge rate structure is in the offing as the FWPCA requires the municipality to recover, through charges, the operational costs and replacement value attributable to the industrial proportion of the Federal grant. For certain replacement equipment based on flow only, a municipal plant devoting 60 percent of its capacity to the general population and 40 percent to industry must recover at least 40 percent of the 75-percent Federal portion if the maximum grant contribution was used. Other replacement costs might be charged by the user's waste strength.

The rest of this chapter will construct a type of analysis for use in making the user-charge-versus private-facility decision. The FWPCA is recent, and its effects on the rate structure are yet to unfold. It would, therefore, be premature to portray accurate cost estimates. One major reason why it is difficult at this stage to estimate user costs is the lack of EPA or other guidelines as to the number of years over which the replacement value is to be recovered from industrial users of a municipal facility.

There are at least three major factors—pretreatment costs, byproduct recovery value, and two sets of operating costs—that must be calculated separately before the final decision phase is consummated.

PRETREATMENT COSTS

The first factor is pretreatment costs for the conditioning or pretreating of its own wastewater by a company before the wastes reach the municipal system. The costs of pretreatment depend on the nature and volume of the wastes, and will vary widely from industry to industry. It is conceivable that very little in the way of expensive equipment may be needed for some industries where pretreatment costs would consist of chemicals and other consumable supplies. Certain other industries will require capital investments for pretreatment, but not quite as large as would be needed for complete private treatment.

The net present value (*NPV*) method of analysis again will be used to calculate a cost for pretreatment. The financial and tax strategy calculations for this equipment are the same as those used in chapters II and III. Further analysis would have to take into account the expected difference in useful life of a private pretreatment facility from that of a municipality.

BYPRODUCT RECOVERY VALUE

It is reasonable that pretreatment will produce byproduct recovery in a meat packing plant; however, the subject is relevant here for its value in a complete private facility. For purposes of this report, the value of annual byproduct recoveries will be described as an offset to the equipment costs.

Byproduct considerations purposely were not examined earlier in the equipment decision phase. The discussion here takes note that before the 1972 FWPCA, byproduct recovery of some degree did exist in the meat packing industry. The emphasis here is owing to the very likely increase in extent of byproduct recovery as events proceed in the meat packing industry.

OPERATING COST DIFFERENTIALS

It is intuitively understood that the annual operating costs for a pretreatment and municipal use system will be less than the costs to operate a private facility. This yearly difference must be assigned an *NPV* to be added to the *NPV* of the private treatment facility. The analytical method is the same as that described in chapter III for a negative cash flow.

MUNICIPAL VERSUS PRIVATE WASTEWATER TREATMENT

To complete the sequence necessary for constructing a municipal-versus-private-treatment analysis, the remaining step is the calculation of an *NPV* for user charges. Using the formula in chapter III, the yearly cash flows for the longest predictable horizon of the user charge system should be valued at *NPV* (as that horizon lengthens, the *NPV* approaches the value that would have resulted if the present value of an annuity had been used where the payments are infinite in duration). The sets of costs now to be compared in the decision process have been adjusted as follows:

- Effective equipment cost - *NPV* of byproduct recovery + *NPV* of greater operations cost = adjusted effective equipment cost for a private treatment facility.

- Effective use charge value + *NPV* of pretreatment costs = adjusted effective user charge value for using a municipal facility.

The basis for a financial decision between the two alternatives is outlined in the foregoing. The financial data can be added to the technical factors that enter into the final decision.

SUMMARY

Figure VI-1 is a flowchart of the analytical guides suggested for choosing the optimum financial strategy for pollution control. The chart summarizes the entire flow of this report. Under the previously defined pollution-control laws it is possible, as was done in chapters II, III, and IV, to use quantifiable examples to optimize tax and financial strategies for equipment decisions (see the area of the chart to the left of the dashed line). Chapter V, while not in the flow, showed how these alternatives may be limited due to specific State programs.

The tradeoffs and factors entering the municipal-versus-private-treatment decision process are shown on the right of the dashed line. They are not quantifiable at this time, and are intended as a guideline at the time when these costs become firmly known.

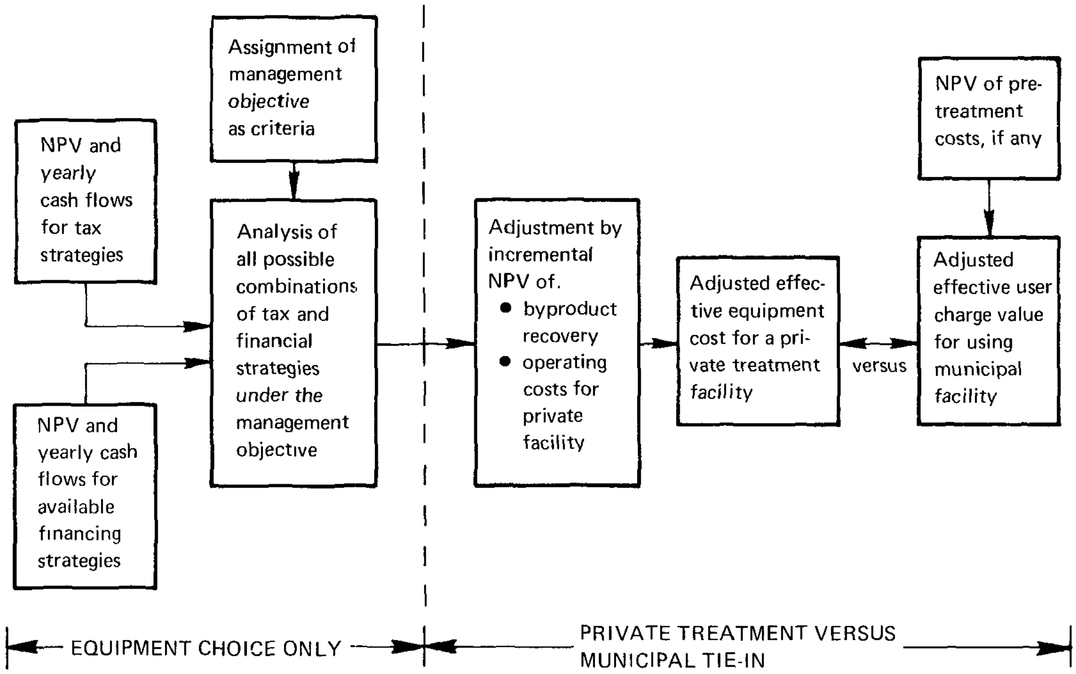

Figure VI-1. Guide to management for choosing the optimum financial strategy for pollution control.

Chapter VII

ILLUSTRATION OF OPTIMUM FINANCIAL STRATEGY FOR POLLUTION CONTROL FOR MUNICIPAL VERSUS ON-SITE TREATMENT

Chapter IV developed various financial decisionmaking processes for management use where pollution-control equipment is bought. These processes took into consideration cash flow and long and short term profit management objectives, and compared various strategies in buying and writing off the equipment. This chapter presents an example of the application of this financial theory where the comparison is between buying equipment for treating plant wastes on site versus municipal treatment costs. This example assumes that the pertinent regulations permit such choice.

Each of the three financial management strategies discussed in chapter VI is complex enough to make it desirable to limit the illustration to one strategy; therefore, theory for all three will not be repeated. For illustration of the analysis for economically choosing municipal versus on-site treatment, the financial strategy analysis of long term profit, which is primarily net present value consideration, will be used. This method, incidentally, is the one used most frequently by EPA in their economic impact studies.

Recalling the costs from chapter VI that were to be used in the comparison, there are for on-site treatment the capital costs that include financing and depreciation, the operating costs, and byproduct values. For municipal treatment, the costs are pretreatment plus the associated operating and maintenance costs and the user charge assessed by the municipality. For the costs of each option to be comparable, the number of years or length of analysis over which the calculations are performed must be the same.

ON SITE

In choosing the length of analysis, the lives of the two alternatives must be relatable for proper costs matching. The user charge cost recovery guidelines to be issued by EPA will have an impact on the length of analysis. One of the guidelines will determine the number of years in which industry's portion of the capital construction cost granted by the Federal Government must be repaid. It is estimated here that the guidelines will specify cost recovery for the shorter of 20 years or the life of the equipment. A 20-year analysis will be used, therefore, for the two alternatives. The meat packing investment used earlier in the report was for 12 years at a cost of $400,000. It is speculated that, even though that equipment could last longer than 12 years, regulatory obsolescence will require updating that will leave an $800,000 cost of on-site treatment over 20 years.

It will be assumed that the on-site equipment will be depreciated and financed by the same methods that were superior in the long term profit analysis of chapter IV; that is to say, double-declining balance depreciation with investment tax credit, and a tax-free pollution-control loan. The terms of the tax-free loan will be repayment of 8 percent of the principal in years 10 through 19, and a 20-percent balloon payment in the 20th year. The tax-free loan rate will be 5 percent.

Because the meat packing plant has to perform all maintenance and operation, those costs must be included, as well as any sludge-handling and disposal costs. Operation and maintenance costs will be considered to be 8 percent of the total facilities investment cost, or $64,000 per year.

Table VII-1 shows how the *NPV* for this example was derived.

Table VII-1.—NPV *of 20-year on-site treatment plant*
[Dollars]

Year	Operation and management	Yearly depreciation	Interest payments	Principal payments	After tax negative cash flow	After tax positive cash flow	Net cash flow *NPV*
1	64,000	[1] 161,600	[2] 80,000		74,160	133,568	[3] 57,678
2	64,000	127,680	40,000		54,080	61,286	[3] 6,792
3	64,000	102,144	40,000		54,080	49,029	4,622
4	64,000	81,715	40,000		54,080	39,223	13,200
5	64,000	65,372	40,000		54,080	31,379	19,583
6	64,000	52,298	40,000		54,080	27,195	22,517
7	64,000	41,838	40,000		54,080	21,756	26,284
8	64,000	33,471	40,000		54,080	16,066	30,010
9	64,000	11,157	40,000		54,080	5,355	37,346
10	64,000	11,157	40,000	64,000	118,080	5,355	83,885
11	64,000	11,157	36,800	64,000	116,416	5,355	80,241
12	64,000	11,157	33,600	64,000	114,752	5,355	76,738
13	64,000	11,157	30,400	64,000	113,088	5,355	73,373
14	64,000	11,157	27,200	64,000	111,424	5,355	70,133
15	64,000	11,157	24,000	64,000	109,760	5,355	67,021
16	64,000	11,157	20,800	64,000	108,096	5,355	64,033
17	64,000	11,157	17,600	64,000	106,432	5,355	61,162
18	64,000	11,157	14,400	64,000	104,768	5,355	58,403
19	64,000	11,157	11,200	64,000	103,104	5,355	55,755
20	64,000	11,157	8,000	160,000	197,440	5,355	106,371
Total *NPV*							886,207

[1] Includes additional first year's depreciation of $2,000.
[2] Includes 5 percent underwriting expense for bond issue.
[3] Positive cash flows, the remaining 18 years being negative.

MUNICIPAL TREATMENT

The size, capital, and operating characteristics of the municipal treatment plant directly influence the fee it charges for treatment. Assume a municipal treatment plant capable of handling 16 mgd. At an approximate capital cost of $1.2 million per million gallons per day, the total plant cost would round out to $19 million. Assume further, for illustrative purposes, that a meat packing plant contributes to 5 percent of this total flow. The flow of the on-site treatment plant for the costs assumed would be for a medium-size meat packing plant with an assumed flow of 0.8 mgd.

Taking the above assumed costs, the following additional assumptions will be made:

- 75 percent of the cost of the construction is provided by Federal grant at no interest.
- 25 percent, or the local-State share, is raised through a tax-exempt bond issue at 5 percent.

- The yearly operation and maintenance of the municipal plant is 3 percent of total investment cost, or $570,000.

- The meat packing plant requires pretreatment equipment that, for the 20-year cost, is $100,000, and is financed via a 5-percent tax-free loan and depreciated via the double-declining balance plus investment credit method.

- The operation and maintenance for the pretreatment facility incurred by the meat packing plant is 8 percent, or $8,000 per year.

The user charge for the meat packing plant thus consists of the following costs:

- 5 percent (percentage flow) of 75 percent of $19,000,000 over 20 years, which equals $35,625 (Federal capital appointment)

- 5 percent of 25 percent of $19,000,000, plus yearly interest of 5 percent on the unpaid balance (local-State capital appointment)

- The *NPV* of the pretreatment capital costs after cash flow considerations from depreciation and financing costs

- Yearly principal and pretreatment operation and maintenance of $28,500 and $8,000

In tables VII-1 and VII-2, the financial choice between buying and treatment on site versus pretreatment and use of municipal facilities results in the pretreatment and municipal facility choice by

Table VII-2.—NPV *of user charges for 20-year cost recovery system*
[Dollars]

Year	Federal portion user charge	Local[1] State portion	Pretreatment operation and management	Pretreatment capital costs			After tax positive cash flow	After tax negative cash flow	Net cash flow *NPV*
				Depreciation	Interest	Principal			
1	35,625	23,750	36,500	21,600	10,000		17,368	55,055	36,589
2	35,625	23,156	36,500	15,680	5,000		7,526	52,146	42,058
3	35,625	22,562	36,500	12,544	5,000		6,021	51,837	41,929
4	35,625	21,968	36,500	10,035	5,000		4,817	51,528	41,503
5	35,625	21,374	36,500	8,028	5,000		3,853	51,219	40,859
6	35,625	20,781	36,500	6,423	5,000		3,083	50,910	40,056
7	35,625	20,188	36,500	5,138	5,000		2,466	50,601	39,140
8	35,625	19,594	36,500	1,581	5,000		759	50,292	39,104
9	35,625	19,000	36,500	1,581	5,000		759	49,983	37,728
10	35,625	18,407	36,500	1,581	5,000	8,000	759	57,674	42,353
11	35,625	17,814	36,500	1,581	4,600	8,000	759	57,160	40,749
12	35,625	17,220	36,500	1,581	4,200	8,000	759	56,643	39,200
13	35,625	16,626	36,500	1,581	3,800	8,000	759	56,127	37,708
14	35,625	16,032	36,500	1,581	3,400	8,000	759	55,609	36,267
15	35,625	15,438	36,500	1,581	3,000	8,000	759	55,093	34,878
16	35,625	14,845	36,500	1,581	2,600	8,000	759	54,576	33,541
17	35,625	14,251	36,500	1,581	2,200	8,000	759	54,060	32,253
18	35,625	13,658	36,500	1,581	1,800	8,000	759	53,543	31,009
19	35,625	13,064	36,500	1,581	1,400	8,000	759	53,026	29,812
20	35,625	12,470	36,500	1,580	1,000	20,000	758	64,509	35,304
Total *NPV*									752,040

[1] Precalculated.

a sizable margin of $134,167. It would not be prudent to extend the implications of this simplified example to a general meat packing industry preference for municipal treatment. One reason is that the value of byproduct recovery was excluded from the on-site and pretreatment facilities. Should the yearly byproduct recovery from on site be greater than that from pretreatment by $17,000 in this example, the two alternatives become equal in value. In addition, note that this chapter is rife with assumptions, since many pertinent regulations are not available at this time. Nevertheless, the chapter can serve as a general guide to completing a more definitive analysis for the plant when appropriate data are available.

Completed now are the analytical financial guides necessary for making the proper choices of treatment alternatives and pollution-control incentives as soon as they are available. In this era of regulatory programs for health and welfare, it is, as demonstrated herein, important to perform the financial analysis with as much zeal as goes into the choice of proper equipment.

METRIC CONVERSION TABLES

Recommended Units

Description	Unit	Symbol	Comments	Customary Equivalents
Length	metre	m	*Basic SI unit*	39.37 in.=3.28 ft= 1 09 yd
	kilometre	km		0 62 mi
	millimetre	mm		0.03937 *in.*
	micrometre	μm.		3 937 X 10^{-3}=10^{3}A
Area	square metre	m^2		10.764 sq ft = 1 196 sq yd
	square kilometre	km^2		6.384 sq mi = 247 acres
	square millimetre	mm^2		0.00155 *sq in.*
	hectare	ha	The hectare (10 000 m^2) is a recognized multiple unit and will remain in international use.	2.471 acres
Volume	cubic metre	m^3		35.314 cu ft = 1.3079 cu yd
	litre	l	The litre is now recognized as the special name for the cubic decimetre.	1.057 qt = 0.264 gal = 0.81 X 10^{-4} acre-ft
Mass	kilogram	kg	*Basic SI unit*	2.205 lb
	gram	g		0.035 oz = 15.43 gr
	milligram	mg		0.01543 gr
	tonne or megagram	t Mg	1 tonne = 1 000 kg 1 Mg = 1 000 kg	*0.984 ton (long)* = 1.1023 ton (short)
Time	second	s	*Basic SI unit*	
	day	d	Neither the day nor the year is an SI unit but both are important.	
	year	year		
Force	newton	N	The newton is that force that produces an acceleration of 1 m/s^2 in a mass of 1 kg.	*0.22481 lb (weight)* = 7.233 poundals
Moment or torque	newton metre	N-m	The metre is measured perpendicular to the line of action of the force N. Not a joule	0.7375 ft-lbf
Stress	pascal	Pa		0.02089 lbf/sq ft
	kilopascal	kPa		0.14465 lbf/sq in

Recommended Units

Description	Unit	Symbol	Comments	Customary Equivalents
Velocity linear	metre per second	m/s		3.28 fps
	millimetre per second	mm/s		0.00328 fps
	kilometres per second	km/s		2.230 mph
angular	radians per second	rad/s		
Flow (volumetric)	cubic metre per second	m^3/s	Commonly called the cumec	15,850 gpm = 2.120 cfm
	litre per second	l/s		15.85 gpm
Viscosity	pascal second	Pa-s		*0.00672* poundals/sq ft
Pressure	newton per square metre or pascal	N/m^2 Pa		0.000145 lb/sq in
	kilometre per square metre or kilopascal	kN/m^2 kPa		0.145 lb/sq in.
	bar	bar		14.5 b/sq in.
Temperature	Kelvin	K	*Basic SI unit*	
	degree Celsius	C	The Kelvin and Celsius degrees are identical. The use of the Celsius scale is recommended as it is the former centigrade scale.	$\frac{5F}{9} - 17.77$
Work, energy, quantity of heat	joule	J	1 joule = 1 N-m where metres are measured along the line of action of force N.	2.778 X 10^{-7} kw hr = 3.725 X 10^{-7} hp-hr = 0.73756 ft-lb = 9.48 X 10^{-4} Btu
	kilojoule	kJ		2.778 kw-hr
Power	watt	W	1 watt = 1 J/s	
	kilowatt	kW		
	joule per second	J/s		

Application of Units

Description	Unit	Symbol	Comments	Customary Equivalents
Precipitation, run-off, evaporation	millimetre	mm	For meteorological purposes it may be convenient to measure precipitation in terms of mass/unit area (kg/m^3). 1 mm of rain = 1 kg/m^2	
River flow	cubic metre per second	m^3/s	Commonly called the cumec	35.314 cfs
Flow in pipes, conduits, channels, over weirs, pumping	cubic metre per second	m^3/s		
	litre per second	l/s		15.85 gpm
Discharges or abstractions, yields	cubic metre per day	m^3/d	1 l/s = 86.4 m^3/d	1.83 X 10^{-3} gpm
	cubic metre per year	m^3/year		
Usage of water	litre per person per day	l/person day		0.264 gcpd
Density	kilogram per cubic metre	kg/m^3	The density of water under standard conditions is 1 000 kg/m^3 or 1 000 g/l or 1 g/ml	0.0624 lb/cu ft

Application of Units

Description	Unit	Symbol	Comments	Customary Equivalents
Concentration	milligram per litre	mg/t		1 ppm
BOD loading	kilogram per cubic metre per day	kg/m^3d		0.0624 lb/cu-ft day
Hydraulic load per unit area, e.g. filtration rates	cubic metre per square metre per day	m^3/m^2d	If this is converted to a velocity, it should be expressed in mm/s (1 mm/s = 86.4 m^3/m^2 day).	3.28 cu ft/sq ft
Hydraulic load per unit volume; e.g., biological filters, lagoons	cubic metre per cubic metre per day	m^3/m^3d		
Air supply	cubic metre or litre of free air per second	m^3/s l/s		
Pipes diameter	millimetre	mm		0.03937 in.
length	metre	m		39.37 in. = 3.28 ft
Optical units	lumen per square metre	$lumen/m^2$		0.092 ft candle/sq ft

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