ECONOMIC AND FINANCIAL

ANALYSIS

VOLUME II

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SECTION 1
OVERVIEW

This volume presents guidelines for preparing the economic and financial portions of an overall feasibility investigation. The other volumes used in conjunction with this one will assist investigators in making a fair and accurate assessment of small hydro project feasibility.

The body of this volume is broken into four major subject areas. It is preceded by an introduction and followed by a summary. The introduction presents general information describing the purpose of the report and the differences between small hydro and large installations. Other discussions on sources of information, ownership characteristics and inflation are also presented.

The market analysis section describes in detail a wide variety of factors that affect the value of a small hydroelectric project. The information in this chapter will be of particular importance to the economic and financial analyst who must prepare the market assessment.

The economic analysis section first discusses the meaning and scope of economic analysis. Recommendations are given on formulating the cost and benefit streams and the appropriate evaluation criteria, and a generalized procedure is developed for applying these techniques.

Several topics that are financial in nature are discussed in the section on project implementation. The institutional requirements, timing of expenditures and sources of feasibility funding are explored.

The financial analysis section presents information pertinent to establishing project financial feasiblity. Funding sources are reviewed as is a method for establishing financial feasibility. A thorough discussion of the important role played by the project's financial advisor is also given.

The report concludes with a summary and cost guidelines for the preparation of the economic and financial portion of the feasibility assessment.

SECTION 2
INTRODUCTION

Scope and Objectives

The primary objective of an economic and financial feasibility investigation is to provide the economic basis for deciding whether to implement a project. An additional objective is to examine the promising development options in sufficient detail to determine which are most attractive.

To achieve these objectives, the scope of the economic and financial portion of the feasibility study must encompass all pertinent engineering, institutional, economic, and financial factors of the project that influence the implementation decision. With the basic project revenue and cost information arrayed in the feasibility study, the project sponsors should then be able to determine if implementing the project is in their best interest. At this point concerns beyond the project, such as capital availability, contractual problems and other factors, are taken into account. These concerns, which relate to the sponsor's overall goals and constraints, are typically not the subject of the feasibility investigation.

Feasibility studies are usually undertaken only when there is a reasonable expectation that the project will be feasible in some form. This may be determined with an inexpensive prefeasibility or reconnaissance study or by expert judgment of a qualified individual. Since all funds spent prior to the decision to implement a project are subject to total loss if the project is not implemented, it is clearly desirable to minimize these expenditures. To do so, intermediary studies that do not yield a definitive answer on feasibility should generally be avoided. Instead, sufficient funds should be expended to determine feasibility, and these results may then be used to either implement the project or reject it and end unnecessary expenditures.

The body of the economic and financial portions of a feasibility investigation are performed in the latter part of the study for the simple reason that they require input from the engineering and other investigations. However, close coordination and exchange of information are maintained with the other investigations. During these investigations, many problem areas may turn up that can render the project infeasible. If the project gets past the engineering and other hurdles, it can then be judged on its economic and financial merits.

The confidence that may be placed in the results of this portion of the feasibility study is a function of the quality of the information used and the analysis performed with this information. The investigation must:

- obtain the best relevant information concerning the value of power production from a small hydro site,
- using this and other information, determine the economic and financial feasibility of the project.

The aim of this report is to describe concepts and provide guidelines for their use in evaluating small hydro developments. A wide variety of situations will occur; therefore, no single procedure will suffice for all projects. For this reason, emphasis has been placed on the proper conceptual framework while providing as much information specific to small hydro projects as possible.

Differences Between Small and Large Hydro Projects

"Small hydroelectric power facilities" are defined in terms of the total nameplate capacity of the generating units and include installations with less than 15 MW of installed capacity. Most projects that fall under this definition would be located at existing impoundments throughout the United States. The U.S. Army Corps of Engineers (Institute of Water Resources, 1977) has estimated the potential at these existing small impoundments to be over 25,OOO MW.

These small projects differ from the over 60,000 MW in existing conventional hydroelectric facilities in four significant ways important to the economic and financial feasibility analysis. First, most projects have relatively low heads (less than 100 feet). Because turbine and other powerhouse costs are more closely correlated to flow than head, the per-kilowatt (kW) cost of powerhouse, switchyard and other miscellaneous equipment can be relatively high. Figure 2-1 illustrates the strong dependence of cost per kW on gross head for new large installations. This will lead to a relatively high capital cost component of total cost in most instances.

Second, the analysis of small projects is usually conducted in the context of a single-purpose, non-essential project. The decision to construct or not construct will generally be based solely on the benefits versus the costs of power production. This is in contrast to many major, multi-purpose projects justified on flood control, recreation and other benefits in addition to the value of power.

Third, most small hydro projects will have little working storage dedicated to power production. This will simplify the operational plan of the project and will also result in the nature of the project's power being different than in most major projects. In the typical small project with little or no storage, there is no ability to store water and schedule peak power generation. Consequently, the project is run-of- the-river, with little, if any, dependable capacity.

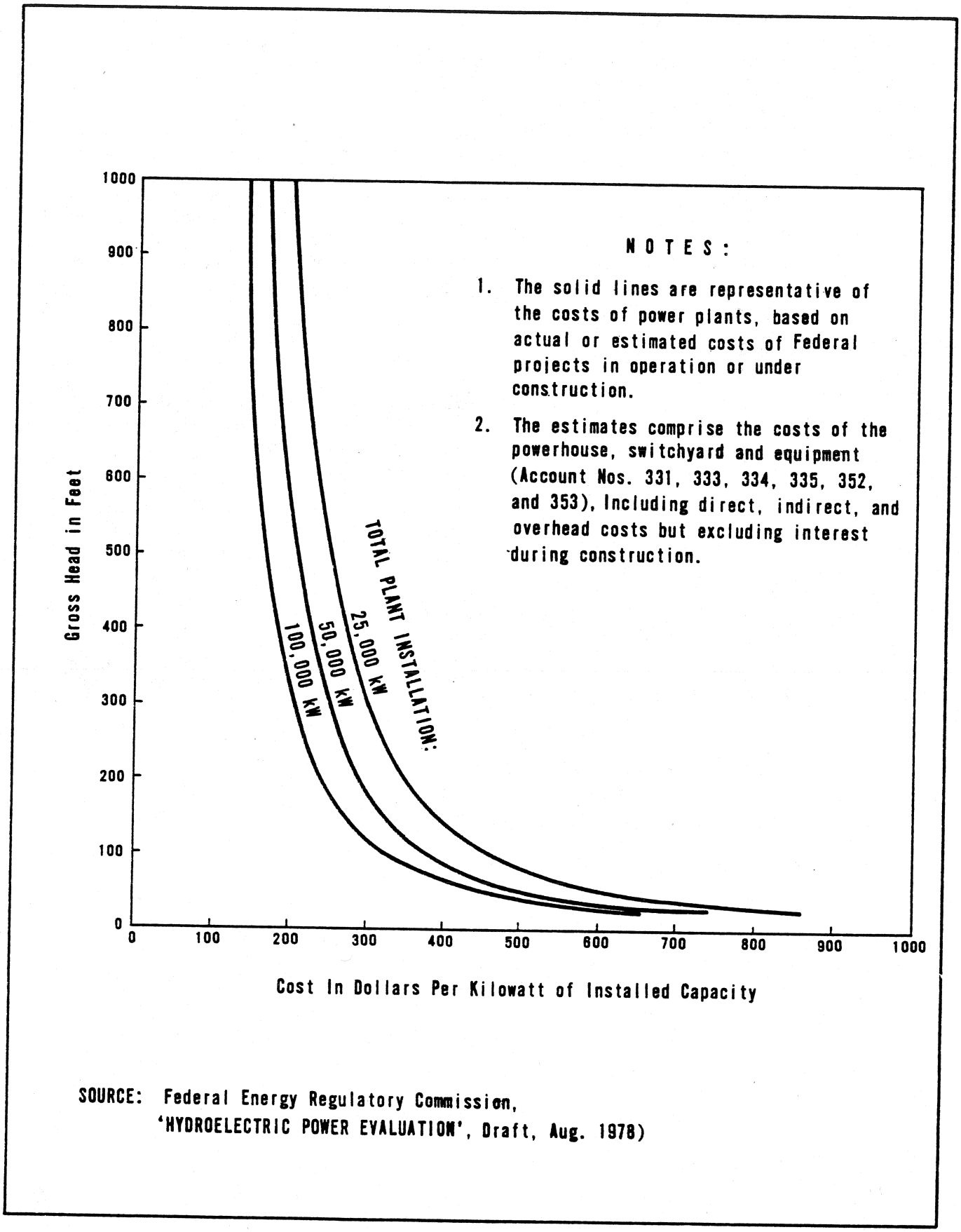

Figure 2-1. Plant installation costs for large hydro projects

Fourth, the cost of service of large hydro projects will include the transmission system to a substation capable of handling a large power input. In small hydro projects with much smaller power output, transmission line costs should typically represent a lesser portion of the total project cost because of the availability of substations and transmission lines that can handle up to 15 MW of additional input. Because of this, the treatment of transmission system costs and losses will be easier to evaluate.

Informational Requirements

All cost, marketing, performance and financial information must be assembled in an orderly fashion. The annual costs and capital requirements will be developed in the civil, mechanical and electrical portions of the feasibility study. These estimates will:

1. Be stated in current dollars of the year the study is performed.
2. Provide a capital cost expenditure pattern for each year of construction. (This will typically be expressed as percentages of the lump sum cost estimate per year.)
3. Indicate whether the costs are subject to escalation.
4. Provide funds for repair and replacement of major equipment necessary for project operation through the financing period. Power production information will be developed by the hydrologic analysis in conjunction with the turbine and generating equipment selections. This analysis will establish the dependable capacity and expected energy production for the development options being considered. The power marketing study will establish the value of the project's capacity and energy output.

The sources and description of the information required for the economic and financial analysis are summarized in Table 2-1.

The power marketing information will frequently be developed by the economic and financial analyst. This information must be carefully prepared since it will be used by the project sponsor in negotiations with the ultimate purchaser. Whether the purchaser is the local utility or one of its customers, the bulk of the information required deals with the utility's existing and planned operations. Some major sources of this information, other than the utilities themselves, are listed and described below.

1. Securities and Exchange Commission Form 10-K — If a privately owned corporation publicly offers securities (stock and bonds) and has over $1,000,000 in assets, it is required to file an annual Form 10-K. This form contains management's detailed statement of operations and audited financial statements and is a valuable source of information. Note that municipal or other public utilities are exempt from SEC reporting requirements.
2. Federal Energy Regulatory Commission (FERC) — Formerly the Federal Power Commission, the FERC requires detailed annual information from both publicly and privately owned utilities. Exhibit I lists and describes the forms electric utilities are required to submit and indicates how they may be ordered.
3. National Electric Rate Book (by state) — The rate book, updated periodically, presents summaries of rate schedules under which electric service is sold to general ultimate consumers by all privately and publicly owned electric utilities operating in urban areas throughout the United States. Many libraries will have the Rate Book or

TABLE 2-1
INFORMATION REQUIRED FOR ECONOMIC AND FINANCIAL ANALYSIS

Source	Information Supplied
(1) Facility Integrity Investigation	Capital and recurring costs or other work required to allow power production at an existing impoundment.
(2) Civil Facilities Investigation	Capital and maintenance costs of site, water-ways, powerhouse and other appurtenant civil facilities.
(3) Electromechanical Investigation	Capital, maintenance and operational costs of turbines, generators and other electrical or mechanical equipment. Also required is the timing and cost of future major repairs and replacements necessary for continued operation.
(4) Hydrologic Study	Annual and seasonal energy production, year to year variations, and dependable capacity. Existing water uses and rights and potential costs that might be incurred to assure water availability.
(5) Power Market Analysis	Value of capacity and energy production from the project.
(6) Economic and Financial Analysis	Cost of capital if not specified by sponsor, and general escalation rate.
(7) Project Sponsor	Capital limitations and cost, cost of land or other right-of-ways, other implementation costs (such as financial consultants) not included elsewhere.

it may be ordered from the U.S. Government Printing Office.

4. State Public Utility Commissions and Public Service Commissions — These are the agencies at the state level charged with regulating utilities; as such, they are important sources of information. It is common practice to establish a formal proceeding to review supply planning, and the record of these proceedings will contain much information on the utility.

5. Industry organizations — Two main industry organizations that have useful information are the Edison Electric Institute (90 Park Avenue, New York, NY 10016) and the Electric Power Research Institute (Box 10412, Palo Alto, CA 94303)

6. Moody's Public Utility Manual — Most public libraries will receive this publication, which provides investment-oriented information.

In some cases, the cost of financing available to the project sponsors will be unknown and must be determined. Generally, large project sponsors will supply this information, so it is the small sponsors, usually public entities, that may be uncertain of their cost of capital. Most of these sponsors will issue bonds to finance their project; hence, the current bond yields will approximate the appropriate cost of capital. *Moody's Bond Record* contains this information and is available in most public libraries. The tax status of the bond interest payments will be an important factor and is discussed in the section on financial feasibility.

Public and Private Ownership

There are two important differences between public and private project sponsors: (1) the taxes levied on private project sponsors, and (2) the differing costs of capital for the two types of owners.

Taxes levied on a privately owned project will effectively increase the project cost and reduce its return when compared to public ownership. Property taxes levied on both real and tangible personal property will result in a direct and escalating annual cost to the project. Because of the definition of property, property tax will be levied on virtually all of the capital cost of the project, and it will usually amount to between 1.0 and 3.0 percent of the capital cost. A publicly owned project will not have this cost.

Private ownership entails a higher cost of capital than does public ownership. State and local government obligations (bonds) are unique in that their holder is exempt from paying federal income tax on their interest payments (D. F. Jacobs, 1972) with certain exceptions contingent on the disposition of the power production. These exceptions are discussed in Section 6. Many bond issues are also exempt from income taxation by the states in which they are issued, through they are seldom exempt from the income taxes of other states. This exemption allows governments to borrow through bond issues at a lower rate than corporations whose interest payments are not exempt from taxation. In addition, the return on corporate equity is taxed on two levels, the corporate income tax and individual income tax dividends, pushing the cost of this component of the corporate capital structure even higher.

Because of the difference in the cost of capital, which can be as much as four to six percent, public entities will generally find a capital-intensive project more attractive than a private sponsor would. In small hydro, it is possible that a project infeasible for a private promoter will be attractive to a public entity.

Dichotomy Between Economic and Financial Feasibility

Economic justification deals primarily with the development and application of benefit-cost analysis. Benefit-cost analysis is an analytical procedure used in the economic evaluation of a project to:

1. Indicate the relative merits of different project configurations by identifying, measuring, timing and comparing project economic benefits and economic costs.
2. Determine the size, geographic scope and capacity of projects.
3. Establish the construction priorities and develop time schedules in energy service areas.

The objectives of the economic feasibility are met by relating all project benefits to project economic costs. This relationship provides relevent comparisons of the feasibility of different small hydroelectric configurations at a given site.

Financial feasibility, on the other hand, takes into account the availability of funds and relates financial costs to project revenues. Project financial costs are those incurred in constructing, operating, and maintaining project work and facilities, and they are elements of the total cost considered in the benefit-cost analysis (economic feasibility).

Inflationary Effects

Inflation will affect both the capital cost of a project and the continuing operations of the project. Furthermore, the effects of inflation must be explicitly accounted for if funds set aside for future repairs and replacement are to be sufficient to accomplish their purpose.

In capital-intensive projects with multi-year construction periods, inflation will lead to substantial increases in completed cost over the lump sum cost estimate. This is because prices for components will escalate between the time of the estimate and their actual procurement. Section 4 illustrates this and shows how to incorporate inflation in estimating completed cost. However, once the project is completed, the repayment of capital costs will generally remain fixed through the project life. In contrast, other project annual costs and revenues will be escalating with the result that capital costs become a decreasing proportion of total cost. This tends to enhance the cash flow later in the project but has little effect in the project's early years of operation.

In performing the economic analysis of a project, it is important that the effects of inflation on the cost and benefit streams be handled in a consistent manner. It is common for governmental agencies to use constant price levels in effect at the time of the study. If this is done, all future costs and benefits need to be expressed in constant price level dollars.

While it is possible to adopt this posture for the economic analysis, inflation must be accounted for in the financial analysis to correctly determine cash flow. Inflation can be explicitly incorporated in the cost and revenue streams by escalating future values by the expected inflation rate. It may also be desirable to escalate different portions of the projects at differing rates, depending on the expected escalation rate. This is particularly true of energy values, since there is a general expectation that the value of energy will rise faster than the general inflation rate.