IMPACT OF ECONOMIC AND FINANCIAL POLICIES ON THE DEVELOPMENT OF SMALL-SCALE HYDROELECTRIC FACILITIES IN NEW ENGLAND

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INTRODUCTION

In conventional water resource analysis, there is a familiar list of features which distinguish major hydroelectric projects from other types of development:

—Hydro projects are typically multiple-purpose projects involving such traditional water uses as navigation, flood control, water quality improvement, water supply, or recreation.
—Operation of individual projects can exert a significant influence on basin hydrology, and as a result, projects within a given basin must be developed and operated in a systematic, integrated manner.
—Due to their size and interdependence and the public good associated with some development objectives, hydro projects are normally undertaken by government agencies.

These features have led analysts to view hydro development from the perspective of the centralized decisionmaker. This mythical figure, assumed to be embodied somewhere within the federal bureaucracy, is empowered by society at large to choose a complementary portfolio of projects for a given region. Implicit in this viewpoint is the notion that certain projects may be unworthy of development when considered in isolation. The synergy of basin development may, however, justify them as elements of a comprehensive development program. Over the past twenty years, a significant portion of water resources research has been devoted to providing the central decisionmaker with analytical tools for the identification of comprehensive programs which efficiently employ the public dollar.

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When the subject is small-scale hydro (SSH) development in New England, however, this traditional "centrist" water resources viewpoint begins to break down, as the interdependence among projects and purposes may be of relatively minor importance in many cases. This fact is especially true in the case of development at existing dams, where the most important effects may frequently be local in nature. This is not to say, however, that there is no regional impact of SSH. The individual contributions from SSH are, when aggregated, capable of reducing the regional dependence on imported oil and providing a renewable energy source. These regional benefits must in turn be balanced against the aggregate side effects associated with a diffuse system of small hydropower facilities.

These considerations, in effect, salvage the centrist viewpoint for the purposes of analysis. There is, however, little evidence to suggest the existence of a single centralized decisionmaker responsible for actually accomplishing the SSH development in New England. In fact, hundreds of individual decisionmakers will ultimately develop the SSH resource. This fact has two important consequences.

First, each individual project must be justified and initiated on its own merit. Projects which, when considered in isolation, are not sufficiently attractive to at least some developer will not be undertaken. Any symbiotic effects which might be exploited under comprehensive, central development are unlikely to be relied upon in an individual investment decision. Thus, for every project which is to be initiated, the following elements must be assembled:

—A developer must emerge who is committed to "making it happen."
—Acquisition of the site and related property must be possible by reasonable means.
—Required licensing must be obtainable.
—Local and regional conflict over alternative uses of the site must be resolvable in favor of SSH development.
—A customer must be identified who is willing to purchase the power.
—Financing must be available.

—The project must be economically attractive to the developer.

Absence of any of these elements would be sufficient to block development at a given site.

The second consequence of the absence of a central decisionmaker is that the attractiveness of individual sites will vary, reflecting the identities of the site developers, and will in most cases differ from what would be attractive under centralized government development. Specifically, developers are unlikely to consider costs and benefits which are external to their own financial situation. For example, improved recreational opportunity, a benefit to society at large, is unlikely to be counted as such unless a positive impact on cash flows can be shown. Similarly, a developer will consider any required income tax payments to be costs. From the larger, central viewpoint, however, these tax payments merely transfer the project benefits from one segment of society to another.

Well-informed policy initiatives must be based on a clear picture of their impacts on the decisionmaking which actually controls the resource. Thus, to understand and influence the development of SSH, one must start with an image of the diffuse decisionmaking process which is occurring at individual sites. SSH project decisions are basically financial ones. Consequently, this article will begin with a simple financial analysis of an individual site and then proceed to the aggregate, regional level.

I. Project Accounting at the Local Level

The first component of any hydro project initiation decision is an engineering feasibility study.[1] Such a study accounts for site-specific details such as hydrology, geotechnical, and construction features and potential use of existing structures and equipment. It should include estimates for the following:

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1. U.S. Army Corps of Engineers, Feasibility Studies for Small-Scale Hydropower Additions—A Guide Manual (1979), contains details of this type of study, including cost information.

—capital costs, including engineering, licensing, construction, and equipment, which costs normally depend directly on the installed capacity for a given site and are conveniently expressed in dollars per kilowatt installed;
—installed capacity, which determines the maximum generation rate possible at any point in time;
—capacity factor, which is the fraction of the maximum feasible energy production, as determined by the installed capacity, expected to be generated in an average year (reflecting downtime for equipment maintenance, hydrological variations, and assumptions concerning the mode of operation); and
—average annual mix of power types (percentages of firm and nonfirm power).

Given this information the developer can estimate the equivalent annual costs of the project. Several of these costs are related directly to the project capital costs, including interest on debt, return on equity, interest during construction, sinking fund payments, and income taxes on equity earnings. In addition, the negative costs arising from investment tax credits and allowable depreciation schedules are also linked directly to the capital costs. It is convenient, therefore, to express all of these costs in terms of a capital charge rate, which is the fraction of initial capital costs required each year of the project's useful life to cover these annual costs.[2]

The following expression for the capital charge rate may be obtained by using standard engineering economics techniques:[3]

$$CCR = \left(\frac{1}{1-f}\right)\left(\frac{1+r}{1+inf}\right)^{B/3}(1-i)\left[1-f\frac{\frac{2}{TL}}{\frac{r+2}{TL}}\right]\frac{1-\left(\frac{1+inf}{1+r}\right)}{1-\left(\frac{1+inf}{1+r}\right)^{PL}}$$

2. A concise derivation of the capital charge rate is given in G. BACKUS, TECHNICAL AND ECONOMIC ASSESSMENT OF SALINITY POWER CONCEPTS 205-13 (1978).

3. Interest during construction is calculated as if the entire expenditure is made two-thirds of the way through the construction period. Depreciation is calculated according to the double declining balance method, assuming a very long project life. The equation as stated yields an annual capital charge in constant (noninflated) dollars.

where CCR = capital charge rate;
r = nominal (inflated) interest rate, reflecting the cost of capital to the developer;
inf = general inflation rate;
f = income tax rate;
i = investment tax credit rate;
TL = tax life for depreciation purposes;
PL = project life; and
B = length of construction period.

The nominal interest rate (r) may be obtained as a weighted average of the nominal rates of return required on debt (r_d) and on equity (r_e), adjusted to reflect the tax savings associated with interest payments on debt:

$$r = (1-f)(1-f_e)r_d + f_e r_e$$

where f_e is the fraction of capital cost financed by equity.

Using these equations and a pocket calculator, one may estimate in a consistent manner all annual project costs, excluding operation and maintenance costs,[4] per dollar of capital cost. The financial parameters listed in Table I[5] for various types of developers are assumed as points of departure.

4. These costs are discussed at text accompanying notes 6-7 *infra*.

5. P. KIRSHEN, SYSTEMS MODELING OF SMALL-SCALE HYDROPOWER DEVELOPMENT IN NEW ENGLAND 12 (1980).

TABLE I
TYPICAL FINANCIAL PARAMETERS

	Entrepreneur	Investor-owned Utility	Municipality	Industry
Tax Life (yrs.)	35	40	0	35
Financial Life (yrs.)	30	30	30	10
Debt/Equity Ratio	80/20	65/35	100/0	20/80
Nominal Return on:				
Debt,%	11	11	7	11
Equity,%	40	13	0	13
Nominal Cost of Capital, %	12.2	8.	7.	11.5
Income Tax, %	52	52	0	52
Investment Tax Credit, %	7	7	0	7
Length of Construction Period (yrs.)	2	2	2	2
General Inflation Rate, %	5	5	5	5

Use of these parameters in conjunction with the capital charge rate equation yields capital charge rates of .126 for entrepreneurs, .077 for investor-owned utilities, .044 for municipalities, and .215 for industry. Thus, to develop the same facility, one expects the yearly costs borne by an entrepreneur, exclusive of operation and maintenance costs, to be roughly sixty percent greater than those borne by an investor-owned utility and forty percent less than costs to industrial developers.

The expression for the capital charge rate makes explicit the impact of a number of financial policies on developers' annual costs. Consider, for example, an increase in the investment tax credit from seven to twenty percent. This change would decrease the capital charge rate by the ratio .80/.93. Thus, the annual costs (exclusive of operation and maintenance costs) attributable to all projects (except municipal projects) are decreased by fourteen percent. Other financial policies, the impacts of which are reflected in the capital charge rate, include income tax reductions, changes in the tax life for depreciation purposes, subsidized interest rates and direct subsidies.

The only significant project costs not reflected in the capital charge rate are the annual operation and maintenance expendi-

tures. It is more appropriate to relate these to the amount of electricity generated rather than to the installed capacity. As a point of reference, we have used 5.6 mills[6] per kilowatt hour in 1978 dollars which is representative of a two megawatt (Mw) facility.[7]

Project revenues result from the sale of electricity and therefore depend in any given year on the price (value) of that product. Revenues can be estimated by use of the following equation:

$$R = IC \times CF \times 8760 \times P/1000,$$

where R = annual revenues (in constant 1978 dollars);
IC = installed capacity in kilowatts (kW);
CF = capacity factor;[8]
8760 = number of hours in one year;
P = average price, mills/kilowatt hour (kWh) (in constant 1978 dollars); and
1000 = conversion from mills to dollars.

One can expect no development to occur at a given site unless the annual costs are more than offset by the annual revenues for the particular developer at that site. In a period when the real value of small-scale hydro generation is rising, one thus expects project initiation when the price (P) reaches the break-even point (P_b) which is equal to the sum of operating and maintenance expense plus capital charges associated with a particular project:

$$P_b = 5.6 + \frac{CC \times CCR}{IC \times CF \times 8.760}$$

where CC equals total initial capital cost in constant 1978 dollars. If we assume entrepreneurial development[9] of a site with capital costs equal to $1500 per kW of installed capacity, and a capacity factor of .58,[10] the break-even price is 42.8 mills/kWh.

The above price equation is easily rearranged to obtain the

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6. A mill is one tenth of a cent.

7. J. AMLIN, ECONOMIC AND TECHNICAL DETERMINANTS OF SMALL-SCALE HYDROPOWER DEVELOPMENT IN NEW ENGLAND 117 (1979).

8. See text following note 1 *supra*.

9. The capital charge rate for entrepeneurs is .126. See text following Table I *supra*.

10. See text accompanying note 17 *infra*.

capital cost per kilowatt hour installed[11] which various developers would be willing to invest, given the price at which their output is valued. For example, assuming a capacity factor of .40 and the capital charge rates mentioned above,[12] a price of sixty mills/kWh would justify a project with capital costs of $1513/kW for an entrepreneur, $2476/kW for an investor-owned utility, $886/kW for industry, and $4332/kW for a municipality.

Hydro projects have long lives, and when SSH value is rising quickly in real terms, developers are conservative in waiting for the price to reach this break-even point before initiating a project. Larger real revenues in later years could offset smaller revenues in earlier years, and depending on the degree of certainty about future prices, developers may choose to initiate projects before the break-even price is reached. Consider, for example, a developer with an inflation-adjusted discount rate of seven percent and a project lifetime of thirty years. If we assume both a constant price increment per year and perfect knowledge and confidence in one's ability to obtain this increasing price, this investment could be profitably initiated 9.75 years before the break-even price is reached.[13]

Naturally, no one has perfect foresight, and investors will significantly decrease or eliminate this anticipatory gap when price changes are very rapid or uncertain. Further, this potential acceleration of development due to expected future price increases could be offset by cases where the developer negotiates a price for his power which will be fixed over a significant portion of the project life. Even in this case, however, it would be reasonable for a constant negotiated price to reflect future increases in SSH value to the consumer. The same economic algebra should make the consumer willing to offer a fixed price which is several years ahead of the actual value at the time of project initiation. It is apparent that policies which increase certainty concerning the future value of hydropower can have a significant effect on the pace of development.

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11. The ratio CC/IC.

12. See text following Table I *supra*.

13. This result is, surprisingly, independent of the size of the yearly price increment.

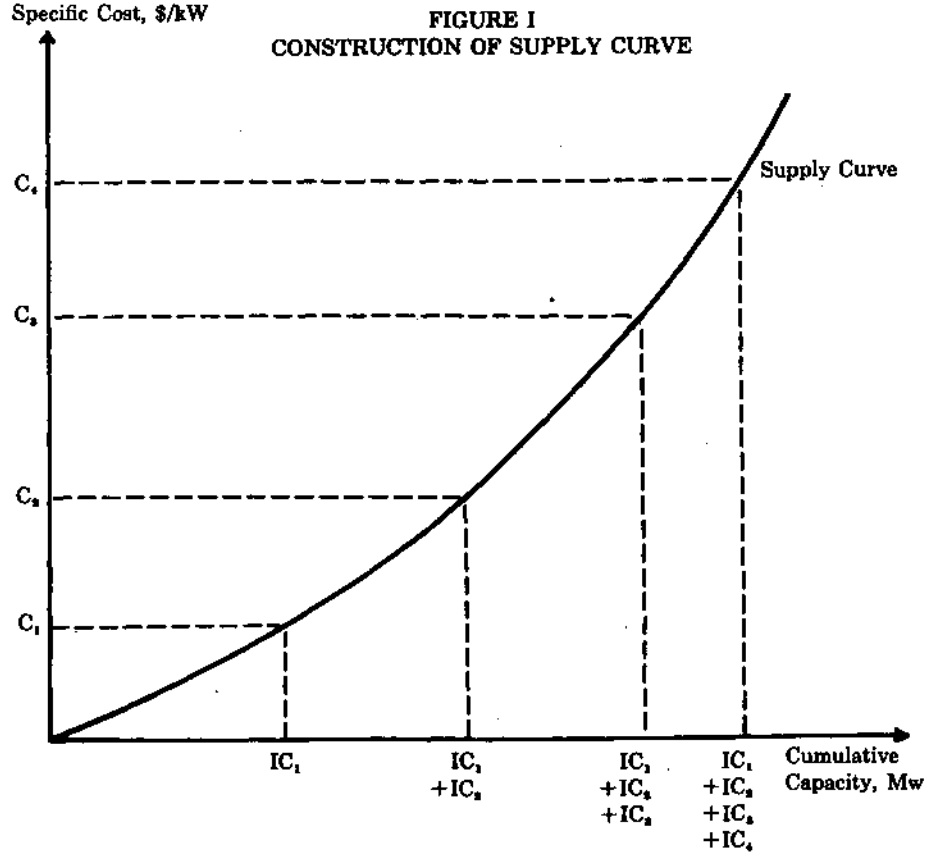
With this simplified image of project initiation and economics, let us turn our attention to the New England region as a whole.

II. Regional Supply Curve

At the regional level the crucial question is not whether a specific site will be developed. Rather, of interest is how much SSH capacity will be developed across the region as a whole, the expected timing of the development, and the impact of present and future policies on this development. For these purposes the regional supply curve is a convenient analytical tool.

Imagine for the moment that reliable estimates for installed capacity and capital cost are available for all sites in the region. A regional supply curve can be constructed by first rank-ordering all the sites on the basis of specific cost—the capital cost per kilowatt of installed capacity—starting with the least expensive. By plotting sequentially the specific cost (C_i) of each site versus the cumulative sum of installed capacities for sites with specific costs less than or equal to C_i, one obtains the regional supply curve.

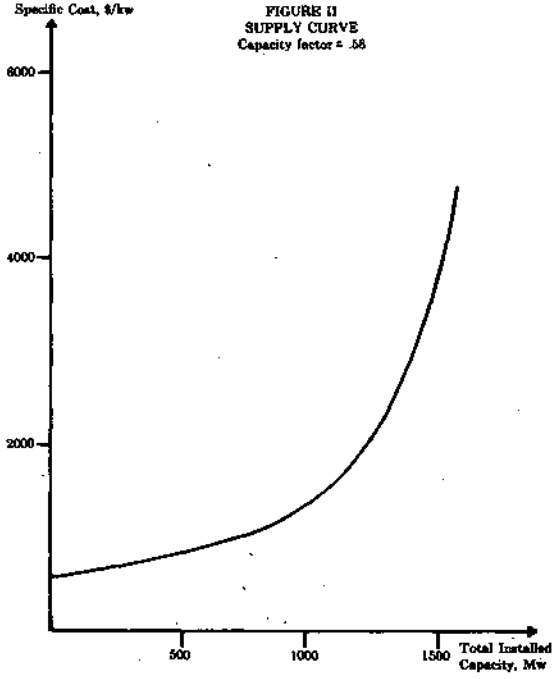
FIGURE I
CONSTRUCTION OF SUPPLY CURVE



In situations such as New England, where there are a large number of small projects, this curve should be relatively smooth.

To be accurate, the construction of a supply curve must account for the presence at any site of significant noneconomic features—such as major environmental problems or competition for other uses of the site—which effectively raise the cost of development or perhaps make the project entirely infeasible. Failure to recognize these features would result in a supply curve which underestimates the cost of development.

Obtaining detailed, reliable information for thousands of individual projects is no easy task, and one often resorts to a variety of surrogate measures.[14] One investigator has estimated the New England SSH supply curve for redevelopment of existing dams (Figure II), using techniques borrowed from the oil and gas literature.[15]



14. *See generally* P. Brown & M. Ringo, Fundamental Economic Issues in the Development of Small Scale Hydro (1979).

15. Amlin, *supra* note 7, at 113.

The supply curve depicts the relation between the specific cost of development and the total amount of development which is feasible at that cost. As conditions change, one imagines the region moving up or down the supply curve as projects which are marginally attractive are initiated or retired. Several factors can cause these shifts along the supply curve, including:

—the value and perceived future value of SSH generation;
—grants, low-interest loans, and other subsidies;
—tax credits and depreciation schedules; and
—regulatory policies affecting price uncertainty or project delays.

All of these factors are sensitive in some degree to manipulation by policy measures.

A basic regional policy-oriented model can thus be obtained by the union of the regional supply curve with the project accounting relations developed above. Whenever any aspect of the economic environment changes, decisions are made by a "typical" investor to initiate or retire projects based on their economic attractiveness. These decisions are then reflected as changes in the regional installed capacity following delays associated with perception of the change, licensing, and construction. This structure is the basis underlying the regional SSH models HYDRO-I and HYDRO-II discussed below.

III. Regional SSH Models

In the fall of 1978 the Energy Law Institute of the Franklin Pierce Law Center (FPLC) undertook a study of the factors influencing SSH development in the nineteen northeastern states. Sponsored by the United States Department of Energy, the study has two purposes: to identify the legal, economic, and institutional obstacles and incentives to SSH development; and to recommend policies that could stimulate development. Under subcontract with FPLC, the Resource Policy Center—a research institute within the Thayer School of Engineering at Dartmouth College—has been responsible for quantifying the regional impact of present and recommended future policies. Two computer models have been developed to assist in this quantitative study; both use the system

dynamics approach to simulate the time-dependent effects of the many factors which influence development.

The first model—HYDRO-I[16]—uses the supply curve illustrated in Figure II, along with the financial parameters given in Table I. The supply curve for HYDRO-I pertains only to development at existing dams. This model has been used to simulate development from 1960 through the year 2000. The capacity factor throughout the simulation period was taken to be fifty-eight percent, which corresponds to the actual average value of this variable from 1960 through 1976.[17] The average price paid for hydropower during any year was estimated from historical data up to 1978; estimates beyond 1978 were based on projections of fuel savings and capacity credit, the latter coming into play in the mid-1980's. Financial decisionmaking in the model reflects the entrepreneurial outlook.[18] It is assumed that the developer forecasts future SSH prices based on past trends and initiates projects so that construction will be completed when the forecasted price equals the break-even price.[19] The actual price paid for hydropower during this simulation period is assumed to rise from roughly twelve mills/kWh before 1970 to fifty mills/kWh in the year 2000, expressed in constant 1978 dollars.[20]

The simulation results indicate a decrease in installed capacity from approximately 670 Mw in 1960 to 620 Mw in 1975, which approximates historical data.[21] According to HYDRO-I, SSH redevelopment begins in 1977. With an allowance for licensing and construction time, this estimate results in a trend of increasing installed capacity beginning six years later. By the year 2000 project initiation has dropped substantially, and installed capacity has begun to level off in the neighborhood of 1000 Mw.[22] At this point

16. *Id.* at 102-96.

17. *See generally* FEDERAL POWER COMMISSION, HYDROELECTRIC POWER RESOURCES OF THE UNITED STATES, DEVELOPED AND UNDEVELOPED (1960-76).

18. See Table I *supra*.

19. See text following note 8 *supra*.

20. AMLIN, *supra* note 7, at 205.

21. FEDERAL POWER COMMISSION, *supra* note 17.

22. AMLIN, *supra* note 7, at 205.

the region has moved along its supply curve to a point where additional development is no longer attractive.[23]

Using this projection as a point of reference, HYDRO-I was used to assist the FPLC staff in preparation of testimony for the United States Senate Finance Committee. At the time, several proposals for changes in the taxation of SSH were under study for potential inclusion in the pending windfall profits tax legislation. These proposals, along with the percentage change in new capacity installed during the period 1980-2000 as forecast by HYDRO-I, were as follows:

1. Allowing fish passages to qualify for the regular ten percent investment tax credit ..... +2%;
2. Allowing all SSH property, including fish passages, to qualify for an additional 10% energy tax credit ..... +24%
3. Reducing the depreciation tax life to twenty years ..... +27%.[24]

The effects of all these proposals were reflected in the model as changes in the capital charge rate and were computed assuming that a) fish passages would be required at twenty percent of all sites,[25] and b) the requirement of a fish passage at a given site results in an increase in that site's total capital cost by one-third. The combined effect of all three proposed policies would be an additional 165 Mw installed between 1980 and 2000, an increase of forty-nine percent over the reference case.[26]

Although qualitatively ranking the effect of policy changes on installed capacity tends to be insensitive to changes in model parameters,[27] the details of HYDRO-I predictions do in fact depend heavily on several assumptions. Perhaps the most important of

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23. For a concise description and critique of HYDRO-I, see P. KIRSHEN, *supra* note 5.

24. *See* B. RAMSEY, P. BROWN & P. KIRSHEN, PROPOSALS FOR CHANGES IN THE TAXATION OF HYDROELECTRICITY (1979).

25. If it is assumed that fish passages will be required at all dams, the effectiveness of proposal number one increases to seven percent.

26. B. RAMSEY, P. BROWN & P. KIRSHEN, *supra* note 24, at 23.

27. P. KIRSHEN, *supra* note 5, at 11, 25-26.

these is the shape of the regional supply curve.[28] For this reason, an improved estimate for the supply curve for existing dams has been incorporated into a refined model, HYDRO-II.

The new supply curve was derived from data obtained from the New England River Basins Commission (NERBC). Assisted by the United States Army Corps of Engineers (Corps), NERBC has developed a data base on the over 10,000 existing dams in New England.[29] Of these dams, 1,748 passed an initial screening for minimum head of five feet and minimum power of fifty kW at a forty percent capacity factor. Total investment cost estimates were then developed by the Corps for these dams. The sites were then ranked according to cost per kilowatt installed, and the supply curve in Figure III was constructed.[30]

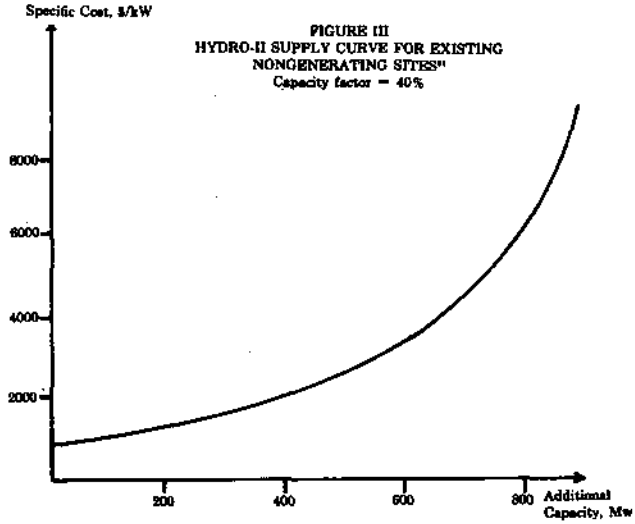

FIGURE III
HYDRO-II SUPPLY CURVE FOR EXISTING NONGENERATING SITES[31]
Capacity factor = 40%

28. *Id.* at 14.

29. 1-8 NEW ENGLAND RIVER BASINS COMMISSION, POTENTIAL FOR HYDROPOWER DEVELOPMENT AT EXISTING DAMS IN NEW ENGLAND (1980).

30. For a discussion of the limitations of these data as well as the characteristics of the distribution of sites along this supply curve, see E. HICKS, EVALUATION AND IMPROVEMENTS TO A SYSTEMS SIMULATION MODEL OF SMALL-SCALE HYDROPOWER DEVELOPMENT IN NEW ENGLAND (1980).

31. *Id.* at 52. The HYDRO-II supply curve is given in terms of constant 1979 dollars. *Id.* at 124.

Additional changes which have been incorporated into HYDRO-II are:

—30¢/$100 state property tax based on 100% valuation minus depreciation;[32]
—ten percent investment tax credit on all equipment including fish passages and an additional eleven percent energy tax credit on all SSH property,[33] to reflect the provisions of the Crude Oil Windfall Profits Tax Act of 1980;[34]
—dam user fees at fifty percent of revenue for federally owned dams, which are assumed to constitute ten percent of the regional potential capacity (resulting in five percent less revenue for the average site);[35]
—beginning in 1980, the pricing provisions of the Public Utilities Regulatory Act of 1978,[36] which requires state public utility commissions to establish rates which will be paid to SSH producers;[37]
—ratio of firm to nonfirm power production for all sites varied between 50/50 and 32/68, depending on the level of environmental and social conflict generated by development (conflict level is determined internally by the model);[38]
—capacity factor of forty percent assumed for all facilities;[39]
—all prices and costs expressed in constant 1979 dollars.[40]

As a point of reference, it was assumed that beginning in 1980, the price paid for SSH would be set by state public utility commissions at sixty-five mills/kWh for firm power and sixty mills/kWh for nonfirm power, in accord with PURPA.[41] Additionally, it was assumed that these guaranteed prices would grow at a real rate of one percent per year.[42] Assuming entrepreneurial development under these conditions, HYDRO-II projects a total of 910 Mw of

32. *Id.* at 234-35.
33. *Id.* at 67-70.
34. Pub. L. No. 96-223, 94 Stat. 229 (1980).
35. E. Hicks, *supra* note 30, at 236-37.
36. Pub. L. No. 95-617, §§ 201-208, 92 Stat. 3117 (1978).
37. E. Hicks, *supra* note 30, at 227-33.
38. *Id.* at 166-222.
39. *Id.* at 126.
40. *Id.* at 124.
41. *Id.*
42. *Id.*

installed capacity in the year 2000.[43] This projection is used as a point of reference for the other projections discussed below.

If prices in HYDRO-II are set at significantly lower levels, the wave of development that was initiated in the late 1970's based on developer-forecast prices is abated, and in some cases nearly vanishes before recovering. Consider, for example, the case of a development with prices of forty-five mills/kWh for firm power and forty for nonfirm power, with a one percent annual increase in those prices. In 1980 the developer-forecast price drops from fifty-eight mills/kWh to the composite price under PURPA of forty-four mills/kWh. Hydro suddenly becomes less attractive, initiation drops off, and installed capacity in the year 2000 is decreased by twenty-one percent in comparison with the reference case.[44]

Higher price growth rates could in part offset this effect. If the same 1980 prices are used, but the real growth rate is raised to four percent, the initiation still drops off after 1980 but picks up again as the temporary decrease in value is overcome by the four percent growth. In this case, installed capacity in the year 2000 is only 8.5 percent less than in the reference projection.[45]

Similarly, higher prices would stimulate development. In the case of developers receiving eighty-five mills/kWh for firm power and eighty for nonfirm power, with a one percent annual increase in those rates, installed capacity in the year 2000 is increased over the reference case by 21.4 percent.[46]

The model results are quite indifferent to reasonable changes in the state property tax rate because of the small percentage of annual costs required to cover this tax.[47] The results, however, are sensitive to state income tax policies. In HYDRO-II it is normally assumed that seven percent of the fifty-two percent income tax is paid to the state.[48] Elimination of state income tax results in an

43. *Id.* at 127.
44. *Id.* at 228.
45. *Id.* at 232.
46. *Id.* at 233.
47. *Id.* at 235.
48. *Id.* at 234.

increase of 2.9 percent in installed capacity by the year 2000.[49] Elimination of dam user fees at federal sites has a similar effect—an increase in installed capacity of 2.1 percent over the reference case in the year 2000.[50]

Conclusion

There are many potential pitfalls associated with the use of computer models, and a common one is putting too much faith in detailed projections. The analyses do in fact rely on the estimation of several parameters, and although the estimates cited herein are reasonable, readers are encouraged to modify the assumptions and to reach their own conclusions. The relative effectiveness of the various policies considered in this article is insensitive to reasonable changes in parameter values. This insensitivity is due in part to the relatively simple structure of the models—the union of the supply curve with financial decisionmaking. In addition, the regional, rather than individual, focus allows the law of averages to operate in the model's favor at several points in the analysis.

A basic conclusion of this work is that certain economic and financial policies can be quite effective in influencing the pace of SSH development. These policies affect the basic unit of regional decisionmaking—the individual developer—and have direct impact where it counts most—the balance sheet. Many studies fail to account for the effects of taxes, depreciation, and the like, thereby missing what appear to be essential elements in the decisionmaking process.

This study has concentrated on the economic aspects of decisionmaking, and a basic assumption has been that most essential considerations involved in project initiation can be described by their impact on project costs and revenues. There are, however, other dimensions of the decision framework of SSH developers which deserve investigation. One of these dimensions is the role of conflict over environmental values and alternative uses of SSH sites. One study has concluded that the levels of conflict associated

49. *Id.* at 235.
50. *Id.* at 237.

with individual sites is *unrelated* to their economic attractiveness.[51] From the aggregate regional viewpoint, then, it is expected that the importance of conflict will be distributed uniformly over the supply curve.

Finally, returning to the traditional water resources perspective discussed briefly at the beginning of this article, policy effectiveness has been defined in terms of additional installed capacity by the year 2000 which implies that the public interest is served by increases in this quantity. Undoubtedly there is a point where this assumption fails—where there is no additional net public benefit obtained by further SSH development. The location of this point on the regional supply curve remains an issue for debate, although the political process is working continuously towards its resolution.

51. R. WHEELER, A PATTERN RECOGNITION APPROACH TO THE ASSESSMENT OF CONFLICT POTENTIAL IN SMALL-SCALE HYDROPOWER DEVELOPMENT 118-31 (1980). A comprehensive set of data concerning the site-specific environmental and social setting was compiled for a pilot group of 37 existing dams in New England. These data were then presented to developers and other SSH experts. Their opinions concerning the potential level of conflict over SSH development at each dam were then collected and analyzed; the result was a conflict ranking for the pilot group, and a procedure for conflict classification which, with care, could be extrapolated to other sites. *Id.* at 131-35.