Appendix C

ASSURING AN ADEQUATE, EFFICIENT, ECONOMICAL AND RELIABLE POWER SUPPLY AND THE ABILITY TO CARRY OUT OTHER PURPOSES OF THE POWER ACT

Introduction

The U.S. Ninth Circuit Court of Appeals' recent decision in *NRIC v. Northwest Power Planning Council* characterizes the fish and wildlife provisions of the Northwest Power Act as "[a]ttempting to balance environmental and energy considerations."[1] The Northwest Power Planning Council's Columbia River Basin Fish And Wildlife program must consist of measures to "protect, mitigate, and enhance fish and wildlife affected by the development, operation, and management of [hydropower] facilities while assuring the Pacific Northwest an adequate, efficient, economical, and reliable power supply."[2] "Assuring" the region of such a power supply implies a reasonable degree of certainty that the objectives of adequacy, efficiency, economy and reliability will be achieved.

The Council must also determine whether the fish and wildlife program is consistent with the purposes of the Northwest Power Act.[3] These purposes include encouraging conservation of electricity and timely repayment of the Bonneville Power Administration's debt to the federal treasury.[4] An adequate, efficient, economical and reliable power supply that includes a healthy and financially viable Bonneville Power Administration is essential to carrying out those purposes.

The Council has examined the effects of fish and wildlife program measures on the ability to assure the region an adequate, efficient, economical and reliable power supply and Bonneville's ability to carry out the other purposes of the Power Act. The fish and wildlife program includes measures that would alter the operation of the hydroelectric system, affecting the amount and value of power produced. The program also includes measures that have significant capital and/or operating costs that would be borne, at least in part, by the power system.

There is a very wide spectrum of views in the region regarding the meaning of an adequate, efficient, economical and reliable power supply. Some hold that it must be considered entirely in the context of the power system that existed in 1980. In this view, an acceptable power supply is one whose characteristics are different than those of the 1980 system in only minor respects. For others, it may mean doing whatever is necessary to accommodate the needs of fish and wildlife, so long as some kind of power system can be maintained that is roughly as adequate, efficient, economical and reliable as those in other parts of the nation.

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[1] *NRIC v. Northwest Power Planning Council* slip opinion at p. 10879 (9th Cir. 1994)/

[2] 16 U.S.C. § 839b(h)(5).

[3] 16 U.S.C. § 839 b(h)(7)

[4] 16 U.S.C. § 839(1), (4).

In general, it is likely that the adequacy, reliability, efficiency and economy of the region's power supply can only be fully gauged in the context of a full revision of the Council's Power Plan. Congress appears to have had this in mind. Congress anticipated that the Council would develop the fish and wildlife program immediately after passage of the Act.[5] In contrast, the Council was given up to two years to develop the power plan. Among its several purposes, the power plan is intended to:

reduce or meet the Administrator's [of the Bonneville Power Administration] obligations with due consideration by the Council for (A) environmental quality, (B) compatibility with the existing regional power system, (C) protection, mitigation and enhancement of fish and wildlife and related spawning grounds and habitat, including sufficient quantities and qualities of flows for successful migration, survival, and propagation of anadromous fish, and (D) other criteria which may be set forth in the plan.[6]

Thus, the fish and wildlife program is part of the power plan, and the mutual impacts of fish and power measures are intended to be examined together.[7] It may be that the potential impacts of a particular fish and wildlife measure look different in the context of a full revision of the power plan than they do during the fish and wildlife amendment process.

This does not mean that, in adopting the fish and wildlife measures, the Council need not make a determination that the fish and wildlife program assures the region an "adequate, efficient, economical and reliable power supply." It must do so. But its determination may recognize that a fuller analysis of the issue will follow in revising the power plan.

This appendix describes the Council's analysis of the balance between fish and wildlife measures and the power system. In summary:

- The Council should adhere to utility industry standards for an adequate and reliable power supply. If fish recovery measures do not allow enough time or flexibility for the power system to adapt, those measures could violate the conditions necessary for an adequate and reliable power supply. The Council's analysis indicates that there are sufficient resources under development, available for purchase in West Coast electricity markets or that could be developed with relatively short lead time to ensure the region an adequate power supply. Although the reliance on purchased power is a departure from traditional regional planning practices, the Council believes it is becoming an increasingly common facet of the emerging competitive power market. The costs of new resources and purchased power have to be considered in the context of the economics of the power system.

- To ensure the reliability of the power supply, system operators need the ability to draft storage projects below elevations required for fish purposes in the event of circumstances that threaten firm loads. Such circumstances include severe weather, loss of major transmission links and loss of major generating units. Furthermore, the operators need some discretion to begin drafting in anticipation of severe weather events, so that the water can reach lower river projects when it is needed. Provided this sort of flexibility is allowed, the reliability of the system can be assured.

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[5] Remarks of Rep. Dingell, Cong. Rec. p. H10683, November 17, 1980.

[6] 16 U.S.C. § 839b(e)(2).

[7] 16 U.S.C. § 839b(e)(3)(F).

- Fish recovery measures may require actions that are not as efficient from the standpoint of the single objective of power operations as current operations. However, the Northwest Power Act clearly expected a balancing of fish and power objectives, i.e., operating the system with multiple objectives. The greatest efficiency has been and should continue to be sought in achieving both objectives. The changes in the efficiency of power operations will, however, have impacts that are considered in terms of the economics of the power system.

- From the standpoint of the region's economy and power system as a whole, it is unlikely that fish recovery measures would result in an uneconomical power supply. The total costs are small relative to regional income. Ignoring the sunk costs in the existing power system, even if Bonneville's customers were to turn to other power suppliers, the resulting power supply would still be relatively economical in relation to the rates paid by other parts of the nation. However, the advantage the Northwest currently enjoys relative to the rest of the nation would be expected to diminish dramatically both as a result of increased costs in this region and decreased costs brought on by competition elsewhere.

- The costs associated with fish recovery measures could prove to be burdensome to some individuals and industries. This is particularly true of electricity-intensive industries. However, the fact, that, on average, the costs of fish recovery are relatively modest in relation to the regional economy suggests that it is possible to redistribute costs if necessary to avoid unreasonable burdens on specific customer groups.

- The Bonneville Power Administration is an integral part of the region's power supply. It is possible for fish recovery measures to cause Bonneville's power supply to be perceived as no longer economical in relation to competing supplies. If a number of customers accounting for significant loads decided to seek other supplies of electricity, Bonneville would no longer collect sufficient revenue to fund fish and wildlife and other purposes of the Act, including repayment of its debt to the federal Treasury. The analysis presented suggests that Bonneville could absorb modest additional fish recovery costs and maintain its ability to be economical in comparison with other electricity supplies. This conclusion, however, is subject to significant uncertainty.

- The variability inherent in Bonneville's revenues also suggests that there may be some years when Bonneville's revenues are such that it could contribute "excess" revenues to support fish recovery measures. This would be contingent on Bonneville having financial reserves consistent with prudent utility practice.

- The Council has identified actions that are necessary to protect, mitigate and enhance fish and wildlife affected by the development, operation and management of hydropower facilities. To successfully implement these actions *and* assure an adequate, efficient, economical and reliable power supply and not subvert the other power purposes of the Act, the region will need to work with the federal government on the allocation of costs. There is a need to implement the fish recovery measures and maintain the Bonneville Power Administration as an economical power supply.

- The Council has identified three possible means of mitigating the impact of fish and wildlife costs on Bonneville. One is to seek federal appropriations or other sources of funding for fish recovery measures. A second is to share as much of the cost of fish and wildlife costs as are attributable to the non-power uses of the Columbia River system as allowed under Section 4(h)(10)(c) of the Power Act. The third recognizes the parallel between fish recovery measures and utility investment that is made uneconomic and therefore no longer recoverable as a result of competitive pressures. Much of the policy debate surrounding the ongoing restructuring of the electricity industry nationwide is focused on the question of unrecoverable or "stranded" investment. A charge for use of transmission and/or distribution systems is the mechanism that is most frequently proposed. The potential for recovering part of the fish recovery costs and/or costs of uneconomic investment in the unfinished Washington Public Power Supply System nuclear projects through a transmission charge should be investigated.

- Finally, while the Council has done considerable analysis in connection with these findings, it is important to recognize that the adequacy, reliability, efficiency and economy of the region's power supply, and the impact of these measures on Bonneville's ability to carry out the purposes of the Act, can be more fully gauged in revising the power plan. Some recommendations submitted in the fish and wildlife amendment process, for example, the Columbia River Inter-Tribal Fish Commission's proposal to establish ramping rates for flow fluctuations at mainstem dams, raise issues of adequacy and reliability that could not be addressed in the fish and wildlife process. The potential impacts of these and other fish and wildlife measures deserve further consideration in the context of a full revision of the power plan.

Adequate Power Supply

The term "adequate" has a generally accepted meaning in power planning. An adequate power supply is one where power resources are either currently available or can be developed in time to meet forecast demands with an adequate reserve margin. "Adequate" is distinguished from "reliable" by the time dimension. "Reliable" relates to the short term, when resources cannot be added (except for spot market or other short-term purchases), while "adequate" relates to the longer term, when resources can be added. Adequacy might also be thought of as forecast reliability.

Fish recovery measures would result in a power supply that was *not* adequate if they reduced the capability of the Northwest power system to such an extent that, on a planning basis:

- existing supplies and/or transmission capability in the West Coast market were insufficient to meet forecast demand; and

- the timing were such that sufficient additional new resources and/or transmission capability could not be developed in time to meet forecast demand.

Given sufficient time, it would be possible to develop sufficient resources to assure an adequate power supply, albeit at some cost. Then the question becomes whether the resulting power system is economical. Nonetheless, the power system cannot be judged to be adequate if existing resources or constraints on the development of new resources were such that it was not possible to acquire sufficient resources to meet forecast firm loads.

Analysis

The analysis of adequacy focuses on the period 1996 through 2000. Fish recovery actions taken during 1995 may be of concern because of their possible effect on system reliability. Beyond 2000, the typical five-year lead time for the development of combustion turbine power plants (Table 1) should allow these plants to be developed "from scratch," providing that the need for new resources is identified and acted upon during 1995.

Table 1

Representative Combustion Turbine Power Plant Development Schedule

Project and site selection, agreement to proceed	12 months
Permitting, preliminary engineering, contracting	24 months
Final engineering, procurement, construction and testing	24 months

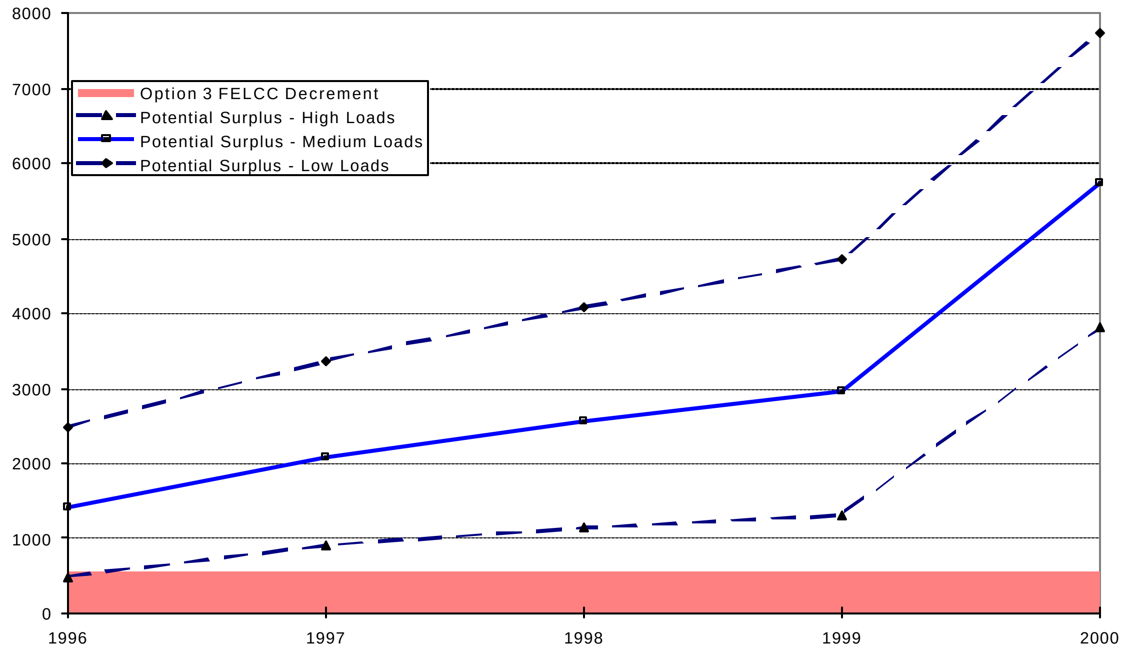
Fish recovery measures could affect both the capacity and energy capabilities of the hydropower system, possibly requiring both replacement capacity and energy resources. However, with the exception of the Detailed Fish Operations Plan, the options considered, while reducing hydropower capacity, are expected to maintain sufficient hydropower system flexibility to preserve current capacity during the regional winter peak period. Adequacy concerns therefore focus on the ability to compensate for the energy impacts of fish recovery programs.

The ability to secure additional resources to meet needs in excess of forecast loads during the period 1996 through 2000 is depicted in Figure 1. Figure 1 shows the firm regional energy load/resource balance. Each line on the figure is the difference between the sum of existing firm resource capability, new resource development potential and additional potential for imports, and the forecast regional loads for low, medium and high growth. The existing capability of the hydropower system is held constant, reflecting hydropower operation under current fish recovery programs. Positive numbers denote a potential supply surplus.

Also plotted in Figure 1 are the estimated decrements to hydropower system firm energy load carrying capability that would result from implementation of Recovery Option 3.[8] Of the recovery options considered (other than the Detailed Fish Operations Plan), Option 3 would produce the greatest reduction in firm hydropower energy during the period of interest. (The 4,700 megawatt firm energy load carrying capability reduction resulting from the Detailed Fish Operations Plan could likely not be fully replaced under medium, or greater, load growth conditions until 2000.) Option 3 firm energy load carrying capability reductions are estimated to be 525 megawatts beginning in 1995, increasing to 550 megawatts in 1999. Though in year 2002, other recovery options might result in greater firm energy load carrying capability reductions, ample time would be available to secure sufficient replacement resources.

[8] In amending the Columbia River Basin Fish and Wildlife Program, the Council analyzed several alternative packages of mainstem measures. These were called “Options”. The Council adopted what was called “Option 7,” whose energy impacts would be less than those analyzed.

Figure 1
Availability of New Resources Compared to Option 3*
Firm Energy Load Carrying Capability Decrement



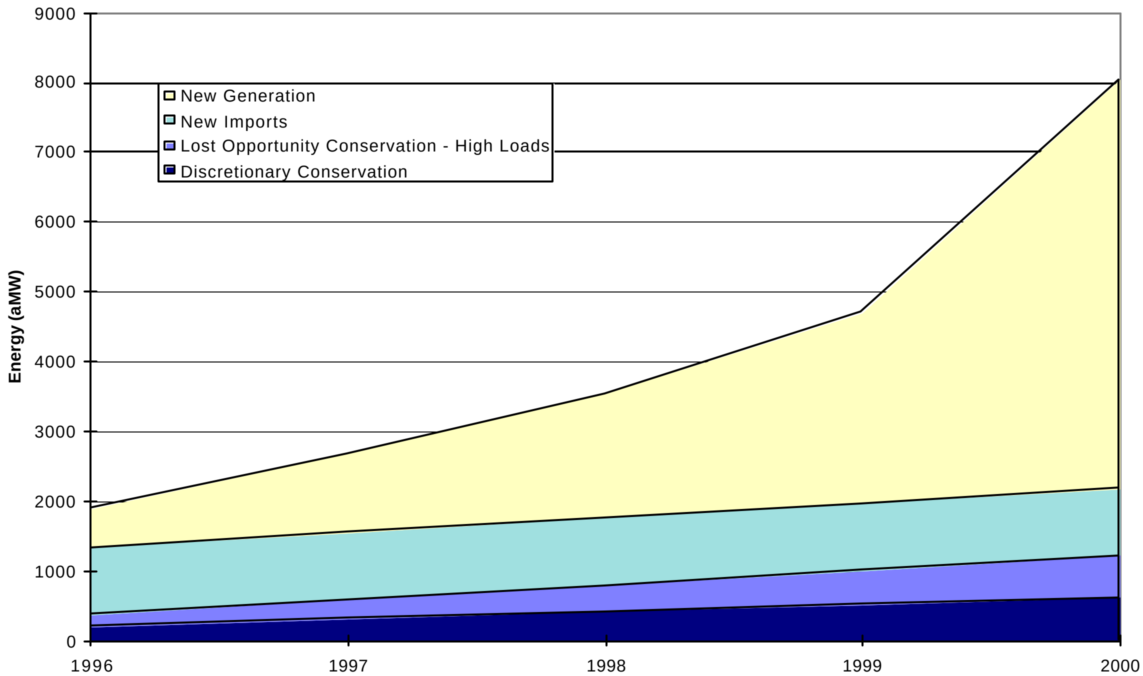
* see footnote

As depicted in Figure 1, it appears to be possible to accommodate the hydropower energy decrements resulting from Option 3 for all load growth cases, In the worst case situation -- high load growth -- sufficient energy could be secured by 1996 to maintain load/resource balance. With continuation of medium load growth, nearly 1,000 megawatts of potential surplus energy could be secured. The potential resource surplus steadily increases through 1999, when it reaches nearly 2,500 average megawatts with medium load growth and 800 megawatts with continued high load growth.

By 2000, sufficient time is available to bring new combustion turbine plants through the full development process, and the amount of potentially available new resources increases rapidly. Beyond 2000, new resource development would be constrained primarily by the availability of suitable sites, resource diversity concerns and environmental constraints. This would probably have the effect of increasing the cost of new resources, as more stringent environmental controls and more extensive site facilities are required. However, it is likely that resources adequate to compensate for the hydropower firm energy load carrying capability reductions of all options save for the Detailed Fish Operations Plan could be secured by 2002.

The new resources that could be secured to offset reductions in hydropower system output include conservation, generating resources developed within the Northwest and increased imports of existing surpluses from British Columbia and the Southwest. Most of the new resources available during the early years of the period are from increased imports from California and British Columbia (Figure 2). Later in the period, an increasing amount of energy could come from steadily increasing new conservation and generating projects (mostly gas combined-cycle plants) under construction, committed for development or in the process of permitting.

Figure 2
Potentially Available New Resources



Conservation resources include all discretionary resources plus lost-opportunity resources corresponding to the respective load growth rates.

Generating resources are based on actual projects under construction or proposed for development, plus a 500 megawatt (capacity) block of new wind resources. The short lead time for wind projects and the competitiveness of wind with combustion turbines under current tax laws suggest that if needed, this amount of new wind resource in excess of currently proposed new projects could be developed by the year 2000.

The potential energy contribution of each new and proposed generating project is estimated as the product of the project capacity, the estimated project availability, the estimated probability of successful project development (permitting, contracting and financing) and the estimated probability of successful project construction. Probabilities are estimated by resource type, based on recent project development experience. For example, the energy contribution of a proposed 240 megawatt gas-fired combined-cycle combustion turbine is estimated to be 164 megawatts, as follows:

Net capacity	240 megawatts
Availability	90 percent
Probability of successful development	80 percent
Probability of successful completion	95 percent
Expected energy contribution	164 average megawatts

The estimated timing of each new generating resource was based on its current stage of development and the expected time to complete project selection, development and construction, as applicable. For example, a combined-cycle project, currently licensed on speculation, but not holding a power purchase agreement, would be estimated to be available for the 1999 operating year, as follows:

Need for power identified	July 1995
Project selection	12 months
Project development	0 months
Project construction	24 months
Initial service date	July 1998
First operating year	1999

Additional imports from California or British Columbia could be limited by the availability of generating resources within these regions to supply power in excess of local needs, by transmission bottlenecks between these regions and the Northwest and by the ability of the Northwest to accept energy during certain periods. The estimates of potential new imports used in this analysis while based on limited information, are thought to be relatively conservative. Both British Columbia and California have resource surpluses available for the period considered, and there is surplus intertie capacity over and above that needed for current long-term contracts. This is true even for the reduced intertie capacity available this winter. The assumptions used in this analysis are shown in Table 2. These figures include the approximately 6,000 megawatt-months needed to store water for fish flows, which are not available to provide firm energy. Those 6,000 megawatt-months have not been included in Figure 2.

Table 2
Estimated Availability of New Energy Imports
(Megawatt-months)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CA	2680	2287	1893	1500	0	0	0	0	1500	1500	1500	1500
BC	0	0	800	800	0	0	0	0	800	800	0	0

Conclusions on Adequacy

The Council finds that the resources either under development or proposed for development in conjunction with reasonable amounts of imported energy are sufficient to assure an adequate power supply under the full range of probable loads and fish recovery measures, with the exception of the Detailed Fish Operations Plan. It would be difficult to accommodate recovery options resulting in very large decrements (thousands of megawatts) of hydropower capability, early within the period examined and maintain power supply adequacy.

The reliance on imports to meet firm power needs is a departure from traditional planning practices in the Northwest. The Council believes, however, that the emerging competitive West Coast power market will encourage a much greater level of sales and exchanges among the regions of the Western system. This will occur regardless of fish and wildlife requirements because it is a more economically efficient use of the power system.

Reliable Power Supply

A non-technical approach to reliability would ask the question: If all the emergency purchases that could have been made have been made, then under all but the most extreme possible circumstances, can all firm loads be met without interruption to the bulk power supply system? In a reliable system the answer is "yes."

As in the analysis above, for the purposes of this analysis, "reliable" means the short-term ability to meet load. It is distinguished from "adequate" by the time dimension. "Reliable" relates to a condition in the short term when resources cannot be added (except for spot market or other short-term purchases), while "adequate" relates to the long term, when new firm resources can be added. Adequacy might also be thought of as forecast reliability.

This analysis proposes to deal only with reliability at the bulk power supply level, since that is generally the level at which the criterion could be applied to fish issues. It does not deal with questions of unreliability at the distribution system level, for example, outages caused by downed distribution wires.

"Load" refers to all firm load. In the case of the direct service industries (DSIs), restriction rights are specified in the contracts, and firm load is the load that is not restrictable. Load can also be distinguished between energy load, which is the total amount of a resource used over some time period and capacity load, which is the amount of resource required at any one time.

Generally, capacity unreliability is a different and more serious kind of problem than energy unreliability, because it is less easily remedied and the consequences (area blackouts) are more severe. Energy unreliability can usually be solved completely with purchases (thus becoming mostly an economic problem), while capacity reliability often cannot be solved merely with purchases, especially in the shortest term of a few hours to several weeks. However, because the Northwest is a hydro-based system, it is possible under certain circumstances, such as the long-term (multimonth) loss of a large resource, like Washington Nuclear Project Two (WNP2), or of an intertie, on top of poor reservoir conditions due to drought, to have energy shortages that would make the system unreliable.

On a forward looking basis, reliability is usually defined probabilistically. Capacity reliability is defined by a certain level of probability that load can be met after taking into account the distribution of forced outages of generating plants and the simultaneous distribution of possible loads, the latter usually based on random weather variations. Because of the interrelationship of water availability and capability to meet instantaneous loads in the Northwest's hydropower system, this measure is not as easily defined as in conventional thermal systems. Work is continuing on this problem, though current results typically address specific contingencies rather than defining them probabilistically.

Energy reliability in the Northwest has historically been based on meeting regional loads with regional resources under critical water conditions. The expansion of the Western regional bulk power market in recent years has allowed utilities to relax their reliance on regional resources, but reservoir status and water conditions still dominate the region's ability to meet its energy loads.

"Reliability" raises the question of voluntary limits on loads. Generally, the definition of "firm load" can be qualified in two different ways, load without curtailments or load after voluntary curtailments. The utilities and the Northwest states have in place a mechanism for calling for voluntary firm load curtailments.

This mechanism will be used before any involuntary curtailments are imposed in a last ditch effort to prevent a widespread blackout of the system. Whatever that level of reliability may be, normal industry usage does not assume the ability to voluntarily curtail load when calculating whether that level can be met. This paper recommends that voluntary curtailments not be part of the definition of a reliable power system.

Increasing reliance on purchased power to meet monthly and annual energy loads has tended to mean that we also increasingly rely on purchased power for energy during periods of peak capacity demand, for instance, during cold snaps. Reliability for this purpose is a much more rigorous test than reliability for annual energy demand. Failure of key intertie transmission lines during a cold snap would have more serious consequences than during other times. For capacity reliability purposes, transmission availability (and the size of the supply market that lies behind it) can be as important as the reliability of a generating plant and needs to be addressed analytically with the same rigor.

The question has been raised whether a system that relies on out-of-region purchases for a significant part of its power supply has the same reliability as one that meets all its needs internally. The implication is that there may be both less reliability from an out-of-region supplier and less reliability as a result of dependence on transmission. This is not necessarily true, though it may be, depending on the facts of the specific situation. In-region plants can go down, as can in-region transmission lines. The Council believes that reliance on a West Coast power market will be a fixture of the emerging competitive market for electricity. The reliability of that market is an issue that can be addressed analytically in the future.

In any case, the Northwest has been relying on out-of-region supplies for some time. Moreover, Bonneville has decided that, over the next few years, it would rely on purchases rather than new resource development because of the economically attractive supply purchase opportunities on the West Coast market and the long-term risk management benefits such purchases can provide.[9] The Council believes that reliance on out-of-region supplies should not be considered, in and of itself, a reason for finding the power supply to be unreliable.

Bonneville reported that there are significant effects on the reliability of the system if certain restrictions on the operation of reservoirs are maintained. Bonneville provided the results of a set of studies evaluating the ability of the federal system to meet monthly energy loads and to meet hourly loads in the event of a severe cold snap this winter. Different levels of restriction on the storage reservoirs[10] as well as the effects of contingencies in large thermal plant operation and intertie availability were examined. The studies concluded that monthly energy loads could be met this winter even if the three U.S. headwater projects (Libby, Hungry Horse and Dworshak dams) were operated at their flood control levels, as long as there were no major problems with the intertie. If there were extended problems, or if Grand Coulee or Arrow dams were required to operate to flood control levels, the system could be unable to meet its firm energy load and could be unreliable.

In addition, hourly capacity studies showed that, during a cold snap, constraining draft on the three headwater projects, even in the absence of contingencies, could lead to firm load curtailments. Libby and Dworshak were more crucial than Hungry Horse in these cases, because their water passed through all the

[9] Bonneville Power Administration, *"Resource Additions to Optimize the Power System -- Developed for the General System Management and Expansion Component of the Power and Resources Strategic Plan,"* March 8, 1994.

[10] Libby, Hungry Horse, Dworshak, Albeni Falls, Grand Coulee and Canadian projects to the extent available under the Canadian Treaty and other agreements.

downstream plants during the simulated cold week, while the water from Hungry Horse was trapped in Flathead Lake by other constraints.

Bonneville's comments noted that operation of fish-constrained projects would be a last resort among the tools available to deal with both capacity and energy reliability problems.

Conclusions on Reliability

One way to address reliability concerns in connection with fish recovery measures would be to put conditions on the use of stored fish water for emergency non-fish reasons. The current fish and wildlife program contains similar flexibility for operation of Dworshak.

A situation testing these issues could come up this winter. A cold, dry winter on top of current low reservoir levels could leave the region exposed to the effects of a cold snap like that of February 1989 or December 1990. In such a circumstance, the ability to meet loads on an hour-to-hour basis (capacity reliability) would depend in part on the ability to release enough water over a short period of time (likely one to two weeks) to support the full generating capability of the system.

Another example of the operation of such a criterion could be support for the Corps and Bonneville's desire to maintain two to three weeks of storage in Dworshak for emergency operating reasons, rather than drafting completely to support fish migration.

To ensure the reliability of the power supply, the system operators need the ability to draft storage projects below elevations required for fish reasons in the event of circumstances that threaten firm loads. Furthermore, the operators need some discretion to begin drafting in anticipation of severe weather events, in order that the water can reach the lower river projects at the time it is needed. The travel time can be as long as three days from some projects to the lower river.

In response to the clarification request by the Power Planning Council to address actions the federal system would take to maintain reliability, Bonneville and the Council developed the following paragraphs:

> To ensure the reliability of the power supply, power system operators need the ability to draft storage projects notwithstanding fish needs in emergency circumstances that threaten firm loads (e.g., major temperature drops like those experienced in 1989 and 1990; loss of a major resource like WNP 2 or a large Grand Coulee unit; or loss of the Northern or Southern intertie). System operators need some discretion to begin drafting in anticipation of severe weather events, so that the water can reach the lower river projects when it is needed. BPA also has the responsibility under the Pacific Northwest Coordination Agreement, the Northwest Power Pool and the Western Systems Coordinating Council to maintain reliability standards for voltage and transmission stability. Instability could result in local or regional blackouts.

Accordingly, during the time of year that water is being stored for fish at the federal projects (Hungry Horse, Libby, Dworshak, Albeni Falls and Grand Coulee), such storage may be temporarily drafted to avoid: 1) threatened inability to meet firm loads due to emergency circumstances (see above); or 2) voltage and transmission instability. Such drafts should be only temporary and should strike an equitable balance between impacts to resident and anadromous species. System operators are expected to make purchases to minimize the risk that there will be less water stored for resident and anadromous fish than would otherwise have been stored. The role of financial considerations in Bonneville's purchase decisions is discussed later in this appendix.

Efficient Power Supply

The term "efficient" is more ambiguous than either adequate or reliable. It could have several meanings in the context of "assuring an adequate, efficient, economical and reliable power supply". Because one of the purposes of the Act is to "encourage development of energy conservation and efficiency resources", one view of an efficient power supply might be one in which electricity is used efficiently. There are conceivably two ways in which fish measures might preclude some efficiency measures. One would be if the performance characteristics of some conservation measures conflicted with the requirements of fish measures. For example, the provision of fish flows in the spring and summer reduce the value of conservation measures that reduce summer loads. On the other hand, irrigation conservation measures that reduce water withdrawals and measures that reduce fall and winter loads and peak demands would have greater value. Taken altogether, this does not seem to be a particularly significant line of reasoning. In developing the power plan, the Council should interpret the cost-effectiveness of all resources in light of their value to the power system, taking fish and wildlife and other objectives into account.

Another way in which fish measures might preclude improvements in the efficiency of the use of electricity would be if the cost of fish measures made investment in efficiency resources impossible. The implication of this is that it would no longer be economically feasible to make such investments. This should be considered in the context of raising a conflict with one of the purposes of the Act.

"Efficient" could also be interpreted in an engineering sense. For example, requirements for spill result in "wasting" water that would otherwise be used for power production. From a power production standpoint, that is inefficient operation of the power system. Similarly, not using "efficient" hydroelectric generation because of fish objectives and running less efficient thermal generation instead results in a less efficient power supply from the standpoint of the average amount of energy used to produce a kilowatt-hour of electricity.[11] In that sense, however, the power system has already become less efficient as more thermal or other generation has been added to the system merely to meet load growth. This trend can be expected to continue. Loss of hydro energy capability will hasten this decline in efficiency, but it is not clear that in the long run, the overall efficiency would be significantly different.

The inability to run the hydro system as a multiyear system with the flexibility to transfer energy from one time period to another suggests a system that is possibly less efficient than it once was. More likely, it means a system which is less flexible. Because the Power Act expressly contemplates electric power losses associated with fish measures, this view of "efficiency" seems too restrictive. Moreover, from a practical standpoint, the consequences of this operation, apart from biological, are subsumed in the economics of the power system. The real question is whether this operation results in a power system that is no longer economical.

[11] From the standpoint of the fuel conversion efficiency of the individual generating units in the system, the system is more efficient than it was in 1980.

It is also worth noting that less efficient power operation will have some associated environmental issues. For example, less reliance on the hydro system will probably result in greater reliance on gas-fired generation that may contribute to global climate change. To the extent those effects are internalized in the future through a carbon tax or some other mechanism, they will show up in the economics of the power system.

Conclusions on Efficiency

The objective of the planners and operators of the power system is a power system that is as efficient as possible given the multiple objectives for the use of system. From the single objective perspective of power operations, the power system is less efficient than it was at the time of the passage of the Act. This is the result of many factors, some of which are just related to characteristics of new resources available to meet growth and some related to the effects of fish recovery measures. It is still, however, a very efficient system relative to systems elsewhere. The Council does not believe that the framers of the Power Act meant the term “efficient” to establish an absolute standard. The Northwest Power Act clearly expected a balancing of fish and power objectives, i.e., operating the system with multiple objectives. The greatest efficiency has been and should continue to be sought in achieving both objectives. Ultimately, the consequences of reductions in the efficiency of the power system are economic -- additional costs to supply a given amount of power. These effects will be evaluated in the context of whether the power system is economical and whether the costs impair Bonneville’s ability to fulfill the purposes of the Power Act.

Economical Power Supply and the Ability to Carry Out Other Purposes of the Power Act

As the discussion of adequate, efficient and reliable suggests, except for a few relatively well-defined circumstances, the overriding consideration is whether the power system is economical. The legislative history suggests that the Council must search for ways to accommodate the needs of fish and the needs of the power system, and if there are trade-offs, must strike a balance. Congress did not intend, however, that fish and wildlife needs should be sacrificed just to save money.[12] The legislative history also suggests that in striking the balance, the Council should consider potential power and revenue losses and costs imposed on consumers. Having done so, the Council should judge whether the power and revenue losses are “unreasonable”, whether the costs “burden” consumers, and whether these losses and costs “subvert the power objectives” of the Act -- in addition to ensuring a stable and affordable power supply, the Act is intended to encourage energy conservation and efficiency; and ensure that Bonneville customers and consumers pay the full cost of power, including repayment of federal Treasury investments.

Burden on Consumers

At what point would additional fish recovery costs unduly burden consumers of the Northwest? This question suggests two possible frames of reference. Because of the national politics of this issue, it may be necessary to look at it from the standpoint of the costs of electricity in this region in relation to the rest of the country. Another frame of reference is the costs in relation to the size of Northwest economy.

Analysis

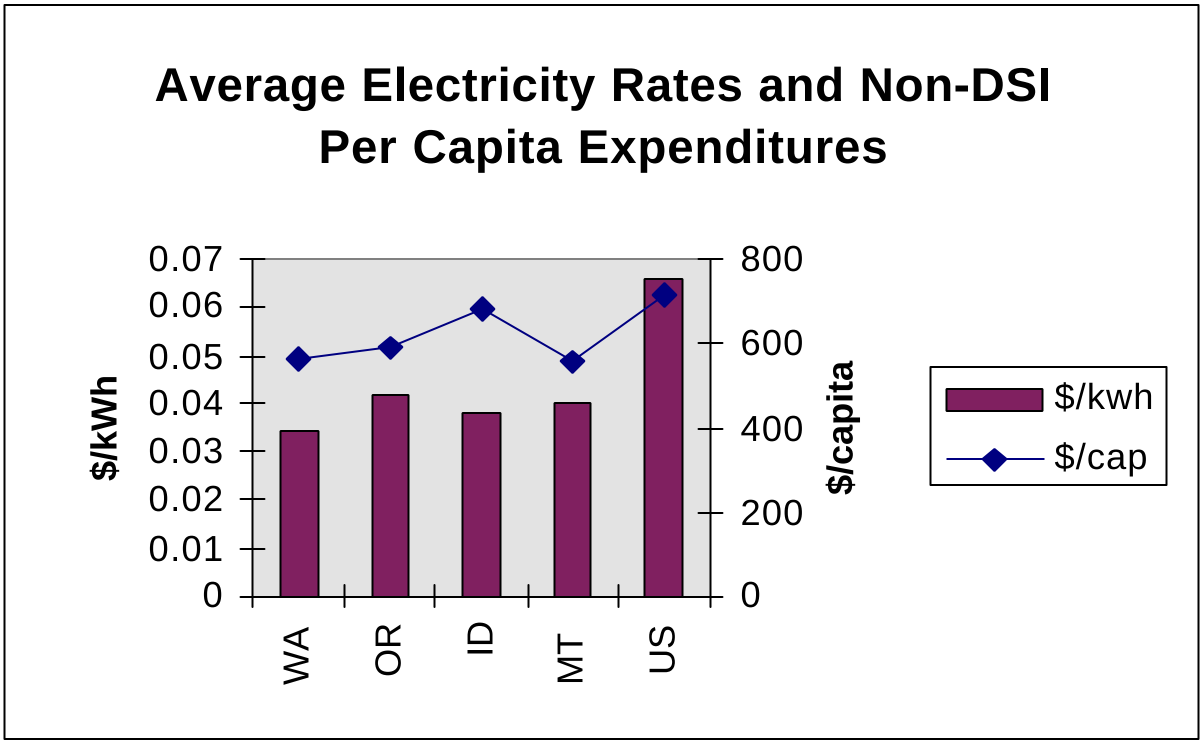
On average, it is unlikely that the magnitudes of the fish recovery costs considered by the Council could be considered a burden for Northwest consumers by others outside the region. Figure 3 shows average

[12] For a more complete discussion of the legislative history, see Volkman, John, "Adequate, economical, etc. power supply," memorandum to Council members, October 6, 1994.

electricity rates and non-direct service industry per capita expenditures for electricity for the Northwest states and the United States as a whole.[13]

The reason Idaho's per capita expenditures are out of line with the rest of the region is unexplained. It may be the consequence of irrigation pumping loads. This figure implies that electricity rates could increase somewhat before average cost for electricity per customer in the Northwest equaled the national average. Increased prices would stimulate conservation and substitution that would moderate the effects of increased rates.

Figure 3



Looking at the issue in relation to the size of the Northwest economy, annual personal income in this region is approximately $200 billion and is forecast to increase at approximately 2.8 percent for the period 1993 - 2005 in real terms and 2.3 percent per year for the period 1993 to 2015. The maximum average additional annual cost of most of the fish recovery measures considered during the program amendment process amounts to less than 0.2 percent of regional personal income. The most expensive, the Detailed Fish Operations Plan, amounts to about 0.4 percent. That option has not been analyzed further. It seems unlikely that, *on average*, this increase over the long term would amount to an unbearable burden to consumers in the Northwest.

From the standpoint of rates, as will be shown later, the increase in Bonneville wholesale rates associated with the costs of the fish recovery measures considered range from almost 2 percent to almost 25

[13] *State Energy Price and Expenditure Report -- 1990,* Energy Information Administration, U.S. Department of Energy, Sept. 1992, pp. 11-16, and *Bonneville Power Administration Annual Report -- 1990,* p.38.

percent. By the time this is passed through to retail consumers, the impact would generally be significantly less. Retail rates in the region would still be significantly less than the rest of the country. Utilities other than Bonneville and its customers would also be affected by fish recovery measures, but not to the same extent.

It should be noted, however, that the historical advantage that the Northwest has had in electricity rates is likely to erode. This is the effect of both the upward pressures on power costs in this region and the anticipated reduction in power costs elsewhere in the nation in response to competitive pressures. Whereas average electricity rates here are typically less than the cost of new resources, the average rates elsewhere are typically greater than the cost of new resources. Competition from new resources can be expected to force rates down in the rest of the United States.

The problem with thinking in terms of the average burden from the standpoint of either rates or overall cost to the economy is the problem with averages -- they frequently do not represent the situation of many individuals and industries. In this instance, there are two problems. First, the costs of fish recovery measures are not spread uniformly around the region. The costs which are the result of derating of the hydropower system or capital additions to that system are recovered through the rates of the Bonneville Power Administration and other utilities with hydroelectric facilities on the Columbia and Snake River systems. Other costs of the fish and wildlife program are recovered through Bonneville rates. How closely this distribution of costs corresponds to the historical distribution of benefits from the Columbia and Snake river hydroelectric facilities is unclear. If the costs of fish recovery and the benefits derived from the hydro system do not coincide, the fact that the costs of fish recovery appear bearable on average may suggest that recovering some of the costs of fish recovery efforts other than through Bonneville power rates is appropriate.

Second, not everyone is an average consumer. Consumers in some parts of the region must cope with a more severe climate than others; consumers in some areas historically have been more heavily reliant on electricity than others; some consumers have lower income than others. Each of these groups and others are more likely to find an increase in electricity costs more burdensome than the "average consumer."

One obvious example is the direct service industries, most of which are aluminum smelters. The cost of electricity is about 20 to 30 percent of the cost of a pound of aluminum, depending on the efficiency of individual plants and the world price of aluminum. Several of the plants in the region are relatively old and inefficient. Absent adjustments in their power rates, which are tied to the world price of aluminum (the Variable Industrial Rate), they might not operate when world aluminum prices are low. Increases in their cost of power would increase the amount of time that they would not operate. If their rates go up sufficiently, the owners of these plants might cease operations in the Northwest, shifting production to lower cost plants elsewhere in the world. Over the long run, this would reduce the need for new resources and reduce power system costs as a consequence. In the short term, however, it would raise rates, unless the power could be sold elsewhere at comparable rates. Public and regional preference requirements could hamper the ability of Bonneville to make such sales.

To assess the relative impacts on particular industries, the data in Table 3 were developed. The first column shows electricity costs as a percent of value of shipments. The others were based on Council estimates of electricity use and average industrial retail rates, and value of shipments from the Annual Survey of Manufacturers. The estimates were for 1990.

The second column shows an estimate of electricity-employment elasticities developed by Bonneville. These were used in the System Operation Review (SOR) to analyze the impact of rate increases on regional industries. For example, a 1 percent increase in retail electricity rates would lead to a -0.1 percent change in employment in the pulp and paper industry, all other things being equal. The assumption used in the System Operation Review was that output changes would be proportional to employment changes, which is reasonable, given the uncertainty of these estimates. There is not a number for the aluminum industry because Bonneville utilizes a detailed aluminum sector model that evaluates impacts on a plant by plant basis. Changes in output are heavily dependent on the forecast price of aluminum. It is important to note that the System Operation Review Draft Environmental Impact Statement concludes that aluminum output would not be affected under any of the rate impacts associated with System Operation Review alternative system operations. The most extreme rate impact was an increase in direct service industry rates of roughly 20 percent over what would have occurred in the no-action alternative. However, this analysis assumes that two plants in the region have already ceased operation.

The last column shows industry percent of total regional employment. These numbers are quite small even for the major manufacturing industries because manufacturing employment is only 15 percent of total employment. The Council used 1993, the most recent historical year.

Table 3

Industry	Electricity Costs as a % of Value of Shipments	Employment-Electricity Elasticity	Percent of Total Regional Employment
Aluminum	20-30	n.a.	0.2
Pulp and Paper	5	-0.100	0.7
Chemicals	6	-0.025	0.3
Lumber and Wood	1	-0.020	2.6
Food Processing	0.5	-0.010	1.9

While the data in the table are of interest, it is important to recognize that each of the industry categories is not entirely homogeneous. For example, within the category of pulp and paper, a plant that uses electro-mechanical pulping technology may have a higher sensitivity to electricity costs than the sector as a whole. Data was also not available for irrigated agriculture. It is clear, however, that for some irrigated agriculture, power costs are a significant factor.

It is impossible to know with any certainty how much of an increase in power rates would result in any of these industries no longer being competitive. There may also be other consumers who could be similarly affected -- low-income consumers, for example. However the fact that, *on average*, the costs of fish recovery would not appear to be an unbearable burden for consumers in the region might argue for exploring other means of recovering the costs of fish recovery efforts or redistributing the costs of recovery to avoid inordinate burdens on particular consumers. Bonneville and retail utilities, for example, have some ability to establish special rates that are designed to mitigate impacts on specific customer classes if there is an overall benefit to doing so. The effect, of course, is to pass the additional costs on to other, less price-sensitive customers. In Bonneville’s case, however, that ability is limited by the competitive alternatives available to its customers.

Repayment of the Treasury and Other Purposes of the Act

The Act requires the Council to assure an adequate, efficient, economical and reliable power system. However, as noted in the introduction, the Council must also determine whether the fish and wildlife program is consistent with the purposes of the Northwest Power Act. Those purposes include encouraging conservation and ensuring that Bonneville customers and consumers pay the full cost of power, including repayment of federal Treasury investments. Bonneville can fulfill neither of these purposes if it cannot recover sufficient revenues to cover its costs. It cannot do so if Bonneville is no longer an economical part of the power supply. The cost of power from the region's hydroelectric system is very low indeed. By itself, it could easily compete with any alternative source of electricity available today. However, Bonneville is faced with recovering all of its costs, including fish recovery costs and repaying debt on the Washington Public Power Supply System nuclear plants. The latter accounts for roughly a fifth of Bonneville's revenue requirements on a net exchange cost basis.[14] In a competitive market, the degree to which costs can be covered through power sales depends on the difference between a utility's rates the cost of alternative marginal resources. Much of Bonneville's ability to cover non-power costs has been "used up" by the Supply System debt.

Given the resources available, past investments in both power resources and fish recovery measures, the evolving competitive wholesale power market, and the possibility of additional fish recovery costs, it is conceivable that there could be an adequate, efficient, relatively economical and reliable regional power system in which Bonneville could not charge enough for its power to recover its costs. If that were to occur, Bonneville would be unable to make full repayment of its debt to the federal Treasury or carry out its other purposes under the Act. If so, the Council could judge that the fish and wildlife program was not consistent with the purposes of the Act. At the time the Northwest Power Act was passed, this possibility was probably inconceivable.

To evaluate the question of Bonneville's competitiveness, it is important to understand the rapidly evolving nature of the electricity industry. The industry is approaching the point of being fully competitive at the wholesale level. This is the consequence of a number of developments and trends in technology, fuels and electricity policy. The primary technology facilitating wholesale competition is the natural gas-fired combined-cycle combustion turbine. The relatively low capital cost, small scale, efficiency and low pollution aspects of the modern combined cycle combustion turbine have lowered barriers to entry into the generation business. Second, current low gas prices and the generally accepted expectation of continued low prices for some time to come have combined with the characteristics of the gas turbine to make it possible for power from new generation to be produced at rates that are significantly lower than those of the best generating technologies of ten or even five years ago.

For more than 15 years, national, regional and state policy has been to promote competition in the generation of power. The Public Utility Regulatory Policies Act of 1978 contained provisions expressly designed to encourage the entry of non-utility generators into the power supply business.[15] State regulatory policies and the Council's plan have encouraged the use of competitive bidding.[16] Finally, the National Energy Policy Act of 1992 further encouraged competition in generation. It created a class of "exempt wholesale

[14] Net of the effects of the residential exchange provisions of the Act.

[15] Public Utility Regulatory Policies Act of 1978, Pub. L. 95-617, Nov. 9, 1978, 16 U.S.C. 2601.

[16] See, for example, *1991 Northwest Conservation and Electric Power Plan, Vol. II, Part II,* pp. 893-900.

generators" that are not subject to the requirements of the Public Utility Holding Company Act and it allows the Federal Energy Regulatory Commission (FERC) to require that the owners of transmission provide open access to their transmission to other power suppliers.[17] The transmission provisions of the National Energy Policy Act apply to Bonneville with some special conditions. The effect is to make it easier for non-utility entities to participate in the generation business and to prevent the owners of transmission, like Bonneville, from denying market access to potential wholesale competitors.

Bonneville’s customers are, with the exception of the direct service industries, utility wholesale customers. In the new utility environment, those customers now have choices. Utility solicitations for bids for new power supply typically elicit responses that total many times the bid amount.[18] These bids come from independent power producers, brokers, power marketers and other utilities. The resulting competition typically drives the costs of the bids down. Even the direct service industries, although not wholesale customers of Bonneville, have choices. If Bonneville were to deny the direct service industries access to its transmission system, these industries can, if necessary, be served by power from combustion turbines located on the industries’ sites.

As a consequence of the choices available to Bonneville’s customers, Bonneville is limited in the cost it can recover in its rates. If those costs become too high or if there is the perception that those costs are going to become too high, customers can choose other suppliers. The recent decision of the Clark County Public Utilities to go forward with a large combustion turbine project is evidence of that. Even though Bonneville’s current and projected rates are probably less than the cost of power from a combustion turbine, Clark’s perception of Bonneville's possible future rates and the risks of total reliance on Bonneville was such that it chose to go ahead with the project.

If customers, like Clark, take load off of Bonneville, Bonneville’s costs must either be recovered from a smaller base of customers, causing their rates to rise and encouraging them to seek alternative suppliers, or the costs must be recovered from the sale of the surplus to other customers, either in the Northwest or elsewhere. Bonneville's ability to make such sales on a long term basis is somewhat restricted by the call-back provisions protecting public and regional preference established in federal law. But even without such restrictions, Bonneville would be selling into a competitive market. Just as its ability to sell to its existing customers is limited by the customers’ competitive choices, Bonneville’s ability to sell to others would be limited by the same choices. Bonneville cannot charge more than market prices for its products. If those prices are not sufficient to recover all its costs, its only recourse is the U.S. Treasury -- in effect, Bonneville’s stock holder. Sustained failure to make timely payment of Bonneville’s treasury debt would clearly violate one of the purposes of the Act.

Analysis

To assess the likelihood that Bonneville’s rates could become uncompetitive, the Council analyzed Bonneville’s future revenue requirements with alternative fish recovery actions compared to the cost of alternative power supplies. For this analysis it was assumed that fish recovery costs could be recovered through Bonneville rates. The analysis was done on the basis of Bonneville’s current electricity sales. If

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[17] National Energy Policy Act of 1992, Pub. L. 102-486, Oct. 24, 1992, 42 U.S.C. 13201.

[18] See, for example, "Snohomish RFP Elicits 47 Proposals Totalling 7943 MW, Mostly CTs," *Clearing Up,* No. 623, May 23, 1994, p. 2; "Regional Utilities Select 1300 aMW through Bidding Solicitation," *Clearing Up,"* No. 622, May 16, 1994, p.4; and "Clark Public Utilities Selects Cogentrix to Build 248 MW CT," *Clearing Up,* No. 644, Oct 17, 1994, p.2.

Bonneville successfully implements tiered rates, tier two sales will compete directly in the marginal power markets. Tier one, however, will serve existing demands and will not grow over time. It is these tier one sales that will be expected to recover the costs of Bonneville's current debts and resources, as well as the costs of additional fish and wildlife mitigation for the hydroelectric system. The central question of the analysis is whether Bonneville's tier one costs can be recovered through power sales revenues.

The costs of Bonneville supplied power are estimated in a simple revenue requirements model. Bonneville's current revenue requirements serve as the starting point. Over time the cost of Bonneville's existing revenue requirements are assumed to decline in real terms by 1.5 percent per year. This reflects an assumption that about 50 percent of Bonneville's revenue requirements are fixed debt repayments that are relatively constant in nominal terms and therefore could decline in real terms at the rate of inflation. At 3.5 percent inflation, this would imply a 1.8 percent nominal increase per year in total existing Bonneville revenue requirements. Assuming 1.5 percent allows for some real cost increases in Bonneville's system aside from fish and wildlife costs, which are examined separately in the analysis.

Total revenue requirements are calculated by adding to the base system costs annual fish and wildlife costs in addition to the Council's Strategy for Salmon for each of the various options being considered. In addition, when existing tier one resources need to be replaced, the cost of new generating and conservation resources are added to the revenue requirements. It is assumed that Bonneville would pay half of the conservation costs, the rest being paid by conservation participants. It is assumed that Bonneville will succeed in building up a financial reserve of about $500 million by the year 2003, with about 60 percent of these reserves rebuilt during 1996 and 1997.

The average rate for Bonneville power sales to both utilities and direct service customers is calculated by first crediting other types of revenues, such as from non-firm sales and transmission charges, and then spreading the remaining revenue requirement over firm power sales. In the base case, with no additional fish and wildlife costs, Bonneville rates are predicted to decrease, in real terms, at about 1.9 percent a year between 1993 and 2015. With 3.5 percent inflation, this would be consistent with a nominal escalation rate of about 1.5 percent a year. This is similar to the average nominal escalation experienced in Bonneville priority firm rates over the last 10 years. Bonneville is in the process of unbundling its products and services. It may be that Bonneville can recover somewhat greater revenues in the sale of unbundled products (e.g., shaping, load following, reserves) than it can from the currently bundled product. This analysis assumes that is not the case. As such, it may somewhat underestimate Bonneville's ability to absorb additional costs.

Additional fish and wildlife costs were estimated based on specific actions included in a selection of the Council's options as presented in Section 5 of the draft fish and wildlife program amendments (Council Document 94-48). The selected scenarios under options 1, 2, and 3 include a variety of actions such as lower Snake reservoir drawdowns to spillway and natural river, and new storage dams on the upper Snake. Costs are estimated separately for capital expenditures, lost hydropower replacement costs and other annual costs. With the exception of the Detailed Fish Operations Plan, these options span the full range of fish and wildlife costs.

Capital costs are generally based on Corps of Engineers' estimates contained in the System Configuration Study. However, the Corps' construction schedules have not been strictly adhered to in the Council's options. Capital costs are allocated to years, and each year's expenditures are assumed to be financed at an interest rate of 7 percent over a 50-year period.

Hydro system firm energy losses and the cost of replacement were estimated using the System Analysis Model (SAM). Critical period analysis is used to estimate loss of firm hydro energy. SAM simulates the operation of the hydro-electric system over the historic critical water conditions between 1929 and 1932. The model attempts to shape water throughout each year to minimize the need for non-hydro generation, while maintaining non-power requirements (such as fish flows, flood control, etc.). The analysis assumed that purchases from the Southwest or Canada could be made in amounts up to 1,500 megawatts for the months of January through April. Estimated losses of annual firm hydro energy are replaced with gas-fired combined-cycle combustion turbines. Under the simulated operation, the replacement combustion turbines operate only about half the time, being displaced by non-firm hydro energy the other half.

Other annual costs for fish and wildlife actions were gathered by Council staff from various sources. These costs include such items as Bonneville fish and wildlife staff and project management, annual operations costs for expanded transportation operations, cost of evaluations, and water leasing and marketing costs.

The initial rate impacts of fish recovery actions are moderated by an assumed demand response to the electricity rate increases. It is assumed that a 10-percent rate increase will decrease electricity demand by 2.8 percent. This demand response is a weighted average of a 5-percent reduction by the direct service industries and a 2-percent reduction by other customers. The demand reductions create a surplus of tier one electricity, which is assumed to be sold for 25 mills per kilowatt-hour. Both of these assumptions are highly uncertain. If the demand response were smaller or the resale rate lower, the rate impacts of fish recovery actions would increase. These demand responses are not intended to predict Bonneville customer decisions to seek alternative sources of power. They are only meant to represent traditional end-user response to price increases.

The rates implied for Bonneville customers as a result of the factors discussed above are compared to the cost of power from a combined-cycle combustion turbine assumed to be built in 1997. The levelized cost of the combustion turbine, in real 1993 dollars, is estimated to be 29 mills per kilowatt-hour under medium gas price escalation assumptions. However, the levelized cost of the combustion turbine is very sensitive to the assumed escalation of gas prices, varying from 21 to 37 mills. Table 4 shows gas price escalation assumptions and the resulting levelized costs for the combustion turbine.

Table 4
Natural Gas and Stand-Alone CCCT Costs

Gas Scenario	Real Wellhead Price Escalation percent/year	Real Variable Fuel Cost Escalation percent/year	Levelized Cost of CCCT (1993 mills/ Kwh)	Real Escalation of CCCT Costs percent/year
Low	-.9	-1.1	20.7	-1.3
Medium Low	.7	1.3	25.1	0.0
Medium	1.9	2.7	28.9	1.0
Medium High	2.7	3.7	32.3	1.7
High	3.6	4.7	36.9	2.6

The costs of the power from combustion turbines needs to be adjusted to make it comparable to power purchased from Bonneville. This is because the Bonneville rate estimates include implicitly the cost of integration services such as shaping, load following, reserves and transmission. It is difficult to estimate the value of these additional products, but the Council has assumed in this analysis that such costs may range from 3 to 7 mills per kilowatt-hour. The lower end of this range is based on staff estimates of the cost of a recent utility contract for integration services. The upper end is based on an analysis of Bonneville's system cost adjustments included in its billing credits program.

Table 5 shows the cost of a combustion turbine integrated into the power system at various gas prices and system integration cost assumptions. The cost of power from a combustion turbine in 1998 varies from 27 to 34 mills, but the lower system integration costs may be more realistic in the near term.

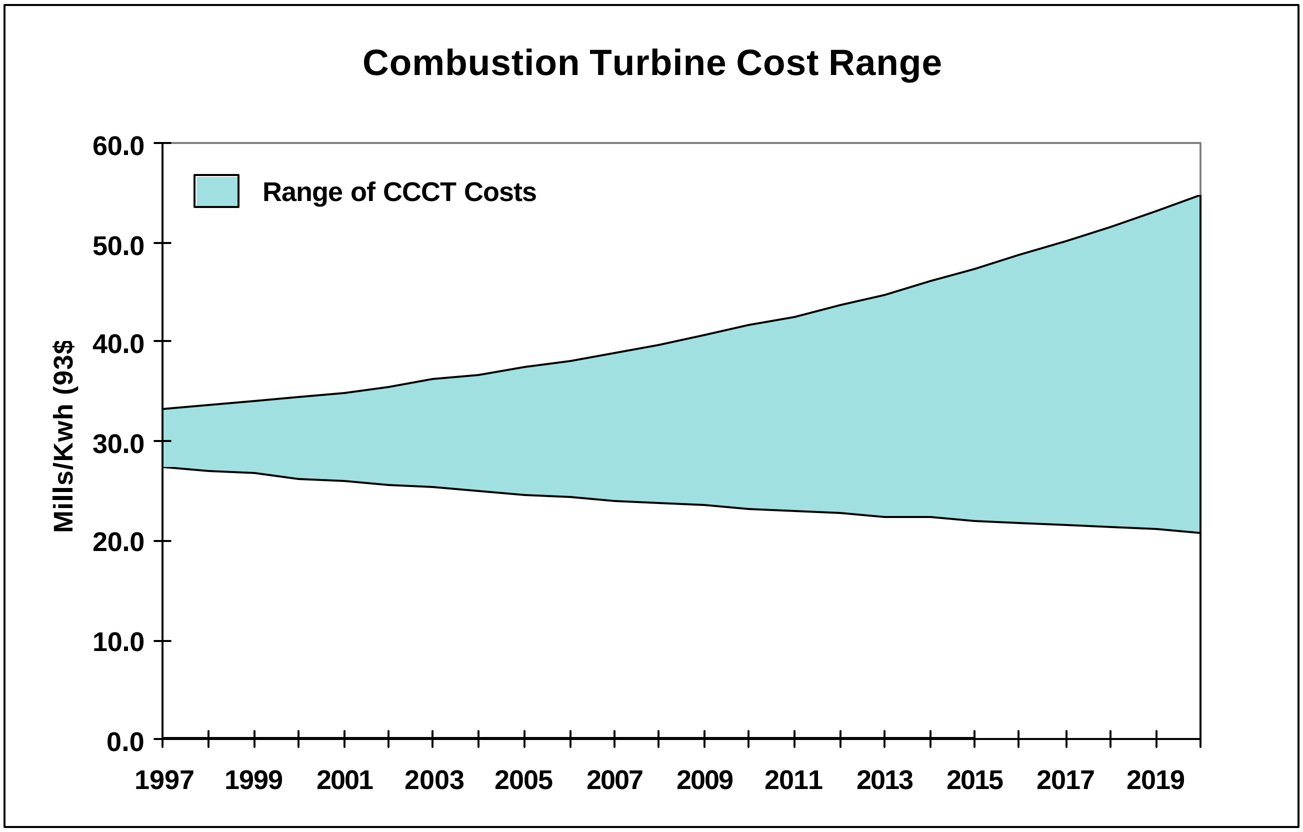
The cost estimates in Table 5 compare well with recent bids received by utilities. Bonneville staff compiled a list of such potential competitors and found average costs in 1998 of 28 mills. The projects costs varied from 22 to 33 mills in 1993 dollars. Bonneville's study also showed that utilities are being offered system sales, which typically include system integration services, at costs averaging 31 mills for 1998 delivery. The system sales and combustion turbine costs are typically either tied to gas prices or escalated in various patterns that average about 4 percent a year in nominal terms, or about 0.5 percent a year in real terms with 3.5 percent general inflation expectations.

Table 5
Integrated CCCT Costs
(Mills per Kilowatt-Hour in 1993 Dollars)

Gas Scenario	System Integration Cost	1998 CCCT Cost	2015 CCCT Cost	1998-15 Escalation Rate	Levelized Cost of CCCT
Low	3	27	22	-1.2	24
Medium Low	4	29	29	0.0	29
Medium	5	31	35	0.7	33
Medium High	6	33	40	1.1	37
High	7	34	46	1.8	40

The resulting range of costs for power over time from the combustion turbine are shown in Figure 4.

Figure 4



In Figure 5, the price of Bonneville electricity has been overlaid on the range of combustion turbine power costs. Instead of a shaded area. as shown on Figure 4, the combustion turbine costs are shown as solid lines for each of the five gas price assumptions. The price of Bonneville electricity is shown for a Strategy for

Salmon base case and for a range of options. The options include those called Option 1 through 3 in the draft amendments. The reader is referred to the appendix of the draft amendments for a description of the options. However, the cost estimates for the options have been revised in response to public comment and additional information solicited since the draft amendment analysis was done.

The net effect on electricity rates relative to the base case varies from a 2.8 percent increase in *average rates* over the 1994 to 2015 period for option 1b to a 16.7 percent increase for option 2b. The effects on rates in 2015 range from a 3.8 per cent increase over the base case to a 25.3 percent increase. This analysis assumes that Bonneville could successfully recover the fish program cost through rates. As subsequent discussion will illustrate, this may not be the case.

Figure 5

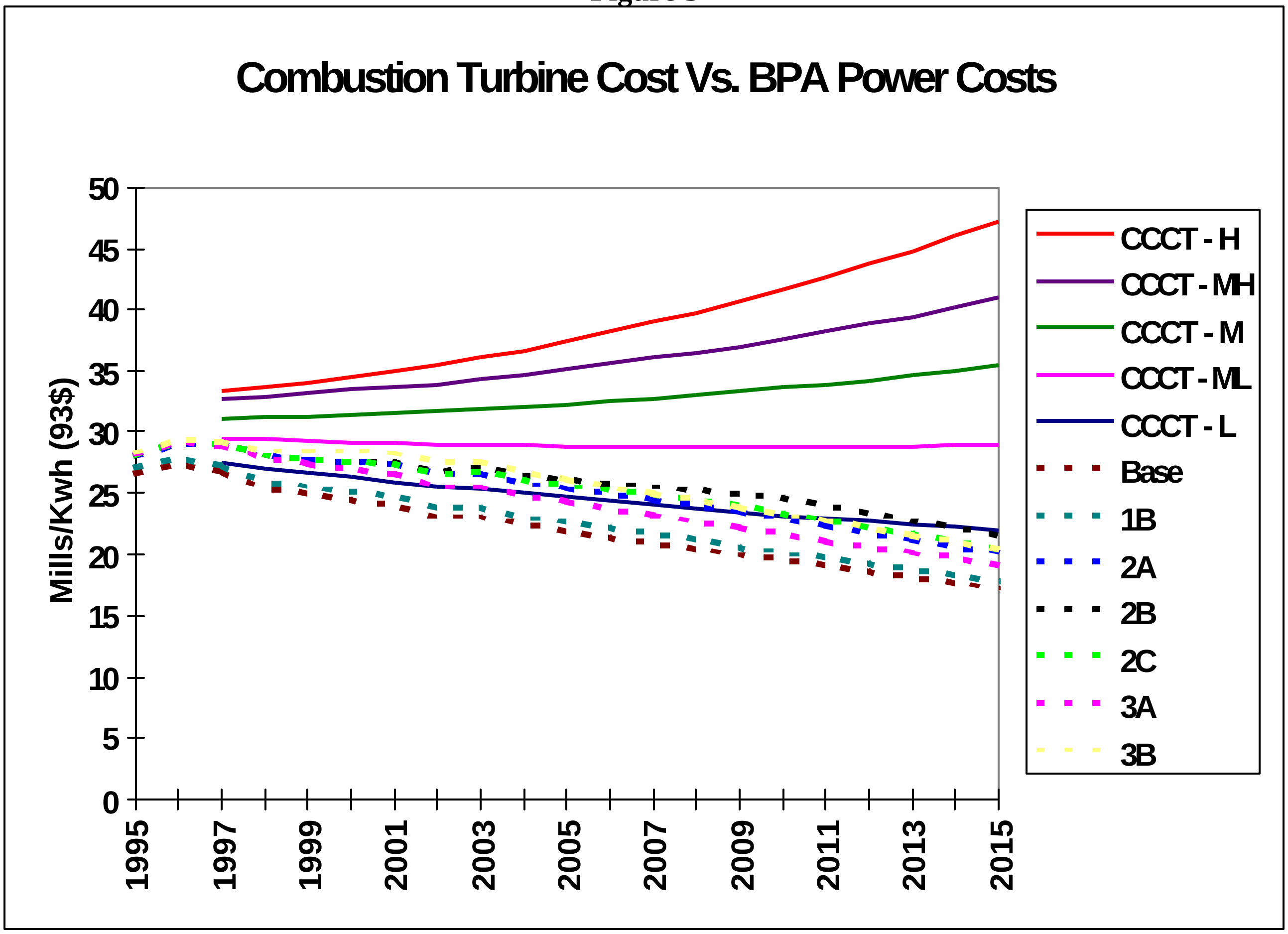


Table 6 shows the levelized costs of the options in three components and in total. Clearly, for all of the scenarios under options 2 and 3, capital costs are the largest component of fish and wildlife costs. The capital costs are dominated by requirements for dam modifications to accomplish drawdowns, or in the case of 3c, to add additional storage reservoirs in the upper Snake. The capital and "other" costs have been allocated to Bonneville. Seventy percent of the energy replacement costs have been allocated to Bonneville. The remaining 30 percent of the energy replacement costs would be incurred by the owners of non-federal projects, primarily those on the mid-Columbia. Most of the cost variation among the scenarios is due to variations in the capital costs.

Table 6
Levelized Cost of Fish and Wildlife Options
(Millions of 1993 Dollars)

Option	Capital Costs	Energy Replacement Costs	Other Annual Costs	Total Costs
1b	5	18	36	58
2a	148	67	52	266
2b	197	73	52	322
2c	168	68	49	285
3a	80	69	50	199
3b	178	87	50	315

Based on analysis and consultation on several alternative options, including those in Figure 5 and Table 6, the Council has focused on a modified set of mainstem actions. These actions are named Alternative A through D. Which of the alternatives are ultimately pursued depends on decisions made in the future after evaluating additional research and testing. The costs and rate effects of Alternatives A through D are presented below. In addition, the costs of only those actions pursued immediately in 1995 are evaluated over time. This case is referred to as 1995.

Table 7 shows the levelized cost components in millions of 1993 dollars. The increased annual revenue requirements would range from $89 million in the 1995-actions-only case to $225 million for Alternative B. Table 7 also shows various wholesale and retail rate impacts and effects on public utility residential customer bills.

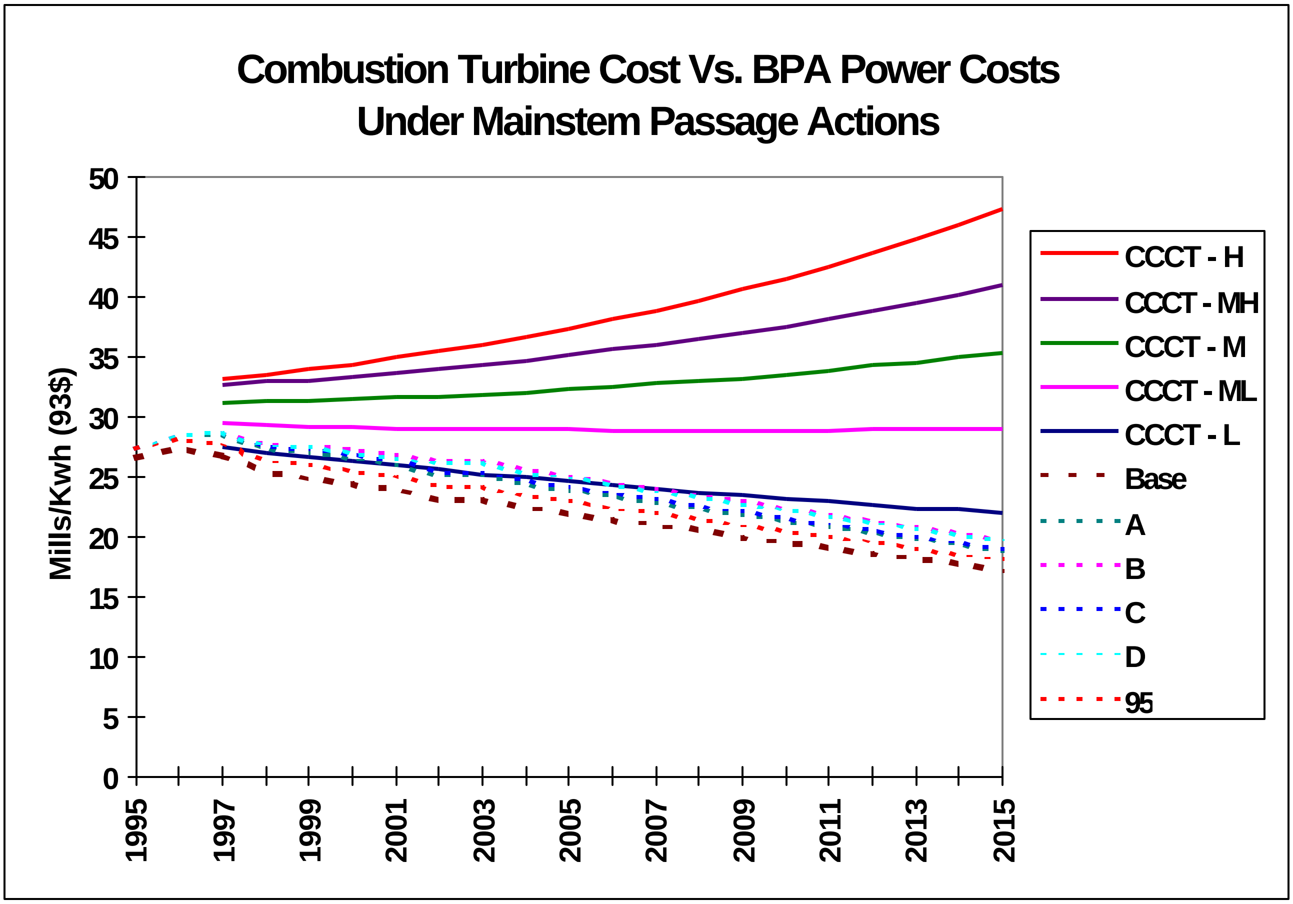
Table 7
Cost and Rate Impact Summary For Mainstem Passage Actions

		Alternative			
	1995	**A**	**B**	**C**	**D**
Levelized Costs (Million 93$)					
Total	89	151	225	170	209
Capital	17	61	108	81	89
Energy	53	69	95	67	99
Other	21	21	21	21	21
Wholesale BPA Rate Impacts					
Average % Impact	3.7	7.2	11.1	8.1	10.3
1997 % Impact	3.3	5.9	6.6	6.2	6.3
2015 % Impact	4.7	9.0	14.6	10.0	13.8
Retail Public Utility Rate Impacts					
Average % Impact	2.5	4.8	7.4	5.4	6.9
Increase in Typical Annual Bill	$15	$29	$45	$33	$41
1997 % Impact	2.2	4.0	4.4	4.2	4.2
Increase in Typical 1997 Bill	$13	$24	$27	$25	$25
2015 % Impact	3.1	6.0	9.8	6.7	9.2
Increase in Typical 2015 Bill	$19	$36	$59	$40	$55

The average increase in rates for the mainstem passage alternatives compared to the Strategy for Salmon base case vary from 3.7 percent in 1995 to 11.1 percent in Alternative B. These percent increases over the base case should not be confused with average annual growth rates. Their meaning is that in a typical future year, Bonneville tier one costs would be, in the case of B for example, 11.1 percent higher than they would have been under the Strategy for Salmon. The near-term rate impacts for 1997 are about 6 to 7 percent in Alternatives A through D. By 2015, these impacts vary from 9 to 15 percent. Retail rate impacts for residential customers of public utilities that rely on Bonneville power would be about two-thirds of the wholesale rate impacts. The increases would imply annual electric bills that are between $30 and $45 higher than those expected under the Strategy for Salmon.

Figure 6 illustrates Bonneville tier one costs under the mainstem passage alternatives compared to combined-cycle combustion turbine costs under different gas price escalation assumptions.

Figure 6



Figures 5 and 6, on the surface, indicate that there is a good chance that Bonneville could cover the expected range of possible fish recovery costs and still compete well with alternative sources of electricity supply. However, such an interpretation may be too complacent. There is uncertainty in the Council's analysis. For example, the rate model used here is relatively simple and may not fully capture all the factors affecting Bonneville's costs and rates.

In addition, there is a great deal of uncertainty surrounding gas prices. Over the past several months, Council staff have repeatedly reduced their gas price forecast in the face of evidence and opinion that gas prices were low and were likely to stay low. If natural gas prices escalate at a rate near the low end of the forecast range, Bonneville tier one power will not be a clear winner. Not included in the above analysis, is the fact that Bonneville power costs will also be increased by low gas prices due to reduced secondary power sales revenues.

Most significantly, the change to competitive power markets needs to be the frame of reference for decisions about the ability of Bonneville to recover costs and support fish recovery measures. Because of the nature of customer's expectations, the flexibility of competitors' actions, and the unknown future cost of competing supplies, Bonneville, more than ever, will need to develop the flexibility to compete in a market.

Currently, Bonneville's customers perceive that there are alternative supplies available at competitive prices. Their expectations are, as evidenced in the offers they are receiving, that natural gas prices can maintained at low levels. For many, the expectations for Bonneville costs are for ever-increasing and uncontrollable fish recovery costs as well as other risks -- repayment "reform" that could alter the terms of Bonneville's treasury repayments and risks associated with the operation of the Washington Public Power Supply System nuclear plant. In the face of these expectations, some of Bonneville's customers are already seeking to diversify their sources of power. At least one, Clark County Public Utilities, has acted to significantly reduce its dependency on Bonneville. In a world where uncertainty is large, some diversification may make sense even when simple calculations seem reassuring.

Bonneville has approached the question of how much additional cost it could take on and remain competitive from a slightly different direction.[19] Bonneville gathered the available information (quantity, cost, characteristics) about specific competitive offers to their customers and others. This information was gleaned from contacts with the customers, public information on responses to solicitations, suppliers and others. Based on this information and their knowledge of their customers, Bonneville estimated the customer response to increases in their rates. These estimates were not based on any explicit analytical model, but on the collective judgments of their account executives, segment managers, marketing staff and others. The results suggest that for a rate increase of 10 percent now, they would realize significantly less than a 10-percent increase in revenues as a few customers chose to put some of their loads on competitors. An additional 10-percent increase in rates (20 percent total) resulted in no increase in revenues, as more customers chose alternative supplies. Any further increase in rates resulted in loss of revenue. As with Council staff's analysis, there was a wide band of uncertainty.

Some might argue that Bonneville's perspective on this question is biased toward a limited capability to absorb additional fish and wildlife costs. Council staff's analysis indicates that in the early years, an immediate 10-percent increase in Bonneville's rates would put it in competition with combined-cycle combustion turbines with gas prices at the medium-low forecast. An immediate 20-percent increase would correspond to the medium gas price forecast. On a long-term basis, Bonneville's rates would look much better. Still, the Council believes it is reasonable to expect some of Bonneville's customers to diversify their power supply away from Bonneville if confronted with those kinds of competitive choices.

Bonneville's ability to recover the costs of fish recovery is almost certain to vary depending on the uncertainties discussed above. In addition, it is likely to vary with seasons of the year and time of day, as the value of electricity changes. The addition of more fixed cost on Bonneville's system will seriously reduce its ability to compete flexibly in the electricity market.

There are likely to be conditions under which Bonneville can generate significant revenues to contribute toward non-power costs, e.g., years with good water conditions and high export demands or perhaps years in which higher than anticipated gas prices allow Bonneville to capture a higher margin on its sales. There may also be conditions in which, if burdened by large fixed costs, Bonneville cannot compete successfully enough to even cover its current fixed costs. The new electricity market calls for new approaches to recovering costs of non-power objectives such as the fish recovery efforts.

Conclusion on Economical Power Supply and Other Purposes of the Act

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[19] *Competition and BPA's Sustainable Revenues,"* Bonneville Power Administration, Market Research, Nov.21, 1994.

It is unlikely that additional fish recovery costs in the range being considered would result in a Northwest power system that is un-economical in relation to the power systems in other parts of the country. It is, however, entirely possible that the kinds of cost increases involved could constitute a burden for specific consumers and relatively electricity-intensive industries. It is not possible for the Council to identify a particular level at which the burden becomes too great. A likely response to increased power costs for at least some major industrial consumers would be to turn to alternative sources of supply not subject to fish recovery costs.

The more immediate concern is that fish recovery costs might seriously reduce Bonneville's ability to compete in the increasingly competitive wholesale power market. Because Bonneville's customers now have competitive choices, they can abandon Bonneville if Bonneville's costs become too high. The effect would be to preclude Bonneville from making timely payment of its debt to the federal treasury -- one of the purposes of the Power Act. The Council's analysis indicates some limited ability to absorb additional fish recovery costs. That ability probably improves with time as Bonneville's existing fixed costs decline in real dollar terms. How great that ability is, however, is subject to considerable uncertainty. To ensure Bonneville's ability to carry out the purposes of the Power Act, the Council should encourage cost-sharing to minimize the additional fish recovery costs that are placed on Bonneville, particularly in the near term. The variability inherent in Bonneville's revenues also suggests that there may be some years when Bonneville's revenues are such that it could contribute "excess" revenues to support fish recovery measures. This would be contingent on Bonneville having reserves sufficient for prudent utility operations.

Although the analysis in this section has focused on long-term costs, Bonneville's ability to repay the federal Treasury can be threatened by short-term and long-term decisions. If Bonneville encountered a reliability problem due to emergency circumstances described earlier in this paper, it might have to make additional short-term purchases to maintain service to firm loads. Prices in such a market would be expected to rise above normal levels, and purchases could strain Bonneville's financial reserves. The Council understands that in making such purchase decisions, Bonneville will consider its financial situation (e.g., financial reserves and its ability to make Treasury repayments), and its obligations under the Endangered Species Act, the Northwest Power Act and other laws.

Mitigating the Impact on the Economics of Bonneville's Power Supply

If the Bonneville Power Administration were a private utility facing the degree of competition Bonneville now faces, it would take several steps to improve its competitive position. One of the more important of these is that it would write down its investment in uneconomic resources. This would cause significant short-term problems for the utility's shareholders, but would ensure the competitiveness of the utility in the long run. Much of Bonneville's investments in the Washington Public Power Supply System are such investments. Supply System debt constitutes about 45 percent of Bonneville's debt and interest costs and roughly a fifth of its net revenue requirement. If part of these costs could be written down, the cost of the fish recovery measures would still be a significant issue, but there would be no question whether those costs could be accommodated while maintaining an economical power supply. However, because Bonneville has no stockholders other than the federal taxpayer, writing down this investment does not appear to be an option.

Although writing down existing uneconomic debt does not seem an option, the fact that the projects that make up the federal Columbia River Power System are multiple purpose projects suggests other means of recovering some of the costs of fish recovery measures. One is to seek federal appropriations or other sources of funding for fish recovery measures. A second is to share as much of the cost of fish and wildlife costs as are attributable to the non-power uses of the Columbia River system as allowed under Section 4(h)(10)(c) of the Act.

A third approach would recognize the parallel between Bonneville's situation with fish recovery costs and uneconomic investment in generation and so-called "stranded investment" and consider the recovery of fish recovery costs through a charge for the use of Bonneville's transmission system.[20]

Federal Appropriations

The recovery of salmon in the Columbia River System is an effort at environmental restoration of unprecedented proportions. The Council should explore with Congress the possibility of federal appropriations or other funding mechanisms for part of the costs.

Section 4(h)(10)(C)

Section *4(h)(10)(C)* of the Act provides:

The amounts expended by the Administrator for each activity pursuant to this subsection shall be allocated as appropriate by the Administrator, in consultation with the Corps of Engineers and the Water and Power Resources Service, among the various hydroelectric projects of the Federal Columbia River Power System. Amounts so allocated shall be allocated to the various project purposes in accordance with existing accounting procedures of the Federal Columbia River Power System.

Earlier this year, on a one-time basis, the federal government concluded that Bonneville could recoup replacement power costs and other costs of carrying out the Council's fish and wildlife program, but could not recoup the value of lost power revenues. The method of recoupment was to reduce Bonneville's repayment to the U. S. Treasury. Under this approach, Bonneville's ability to repay the Treasury would be determined after the Treasury repayment obligation is reduced to account for a portion of fish and wildlife program implementation costs.

Recovering Costs through a Transmission Charge

In jurisdictions where retail competition is being considered, a transmission or "wires charge" is being considered to allow utilities to recover at least part of the costs of otherwise stranded investments through a charge for the use of the utilities' transmission and distribution systems.[21] Much of the policy discussion surrounding electric utility deregulation has to do with stranded investment.[22] The Federal Energy Regulatory Commission recently issued a notice of proposed rulemaking on stranded investment involving wholesale as

[20] "Stranded investment" refers to past utility investment that can not be recovered in power rates because of competitive pressures.

[21] California Public Utilities Commission Order Instituting Rulemaking and Order Instituting Investigation: On the Commission's Proposed Policies Governing Restructuring California's Electric Services Industry, Docket No. R.94-04-031, April 20, 1994.

[22] For example, see Pierce, Richard, "The Advantages of De-Integrating the Electricity Industry," *The Electricity Journal,* November, 1994, p. 20; and *Public Utilities Fortnightly,* Nov 15, 1994, pp. 6 - 7 and pp. 16 - 18; for just a few recent examples of the debate on stranded investment.

well as retail transactions.[23] A recent decision by the Circuit Court for the District of Columbia appears to restrict the treatment of stranded investment.[24] The issue, however, is far from resolved.

Fish recovery costs and/or supply system debt can be thought of as analogous to stranded investment. Fish recovery costs, in effect, represent the internalization of environmental damages caused by the past investment in the hydroelectric system. As a result of the competitive environment that exists today, the beneficiaries of those past investments, Bonneville's customers, may be able to strand the fish recovery costs by leaving the system. Similarly, the Supply System costs were incurred by Bonneville for the benefit of a large number of utilities. Today's competitive market may enable these utilities to strand this investment.

Bonneville controls about 80 percent of the transmission in the region as well as large parts of the intertie. If fish recovery and/or Supply System costs were allocated to transmission, it would lessen, but not eliminate, the ability of customers to avoid fish recovery costs by turning to alternative suppliers.

This would be a very difficult and contentious issue. It could result in costs falling heavily on particular utilities that currently participate in the transmission market. It would also not preclude avoidance of fish recovery or Supply System costs by using other transmission providers and by siting alternative supplies to avoid use of Bonneville's transmission system. The extent to which this kind of cost allocation to transmission would be consistent with Federal Energy Regulatory Commission regulation is unclear.

Conclusion

The Council should actively pursue all means for paying for fish recovery measures in addition to using Bonneville power rates.

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[23] Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, 59 Fed. Reg. 35274, July 11, 1994.

[24] Cajun Electric Power Coop. v. FERC, 28 F. 3d 173, D.C. Cir. 1994