APPENDIX I

ENVIRONMENTAL COST METHODOLOGY

METHOD FOR DETERMINING QUANTIFIABLE ENVIRONMENTAL COSTS AND BENEFITS

Priority is given in the plan to resources that are cost-effective. The Bonneville administrator is required to estimate all direct costs of a resource or measure over its effective life to determine whether a resource or measure is cost-effective. Quantifiable environmental costs and benefits are among the direct costs of a resource or measure. The Northwest Power Act requires the Council to include "a methodology for determining quantifiable environmental costs and benefits'' in the plan. This methodology will be used by the administrator to quantify all environmental costs and benefits directly attributable to a measure or resource.

Proposed method

A. Identify the characteristics (technical, economic, environmental and other) of the resource or measure in question. Quantify each identified environmental effect in terms of the physical units involved (e.g., acres of habitat, tons of sulfur dioxide, change in water temperature).
B. Identify all potential environmental costs and benefits (e.g., the economic value of the effects of changes in the environment) that will result from the resource or measure. Research to identify the environmental costs and benefits of each resource should be continued by Bonneville in light of advancing knowledge about environmental impacts and of technical changes in resources.
C. Screen the identified environmental costs and benefits to determine whether a meaningful economic evaluation should be performed. Consideration should include:
    1. whether economic techniques are sufficiently developed to allow for a meaningful analysis of environmental cost or benefit,
    2. whether sufficient information exists or can reasonably be obtained to allow for an analysis of the environmental cost or benefit;
    3. whether the relative cost-effectiveness of alternative resources is such that the as yet unquantified environmental costs and benefits would likely affect the decision on resource cost-effectiveness.
D. Assemble an information base for each environmental cost and benefit that can be quantified. Assess the uncertainty affecting the ultimate quantity estimates. Consider federal, state and local studies of such environmental costs and benefits, scholarly and professional quantifications, and data obtained as a result of public comment.
E. Select a specific economic evaluation method based on the type of environmental cost or benefit; data available; experience with the method (e.g., has it been successfully used in the past); and type of uncertainties involved. The strengths and limitations of the evaluation method should be documented. More than one evaluation method may be needed to cross check and verify results.
F. Describe and, if possible, quantify key physical and biological parameters for those environmental costs and benefits where it is not possible to develop monetary values.
G. Compile a record that describes the resource, indicates what impacts were identified and which measurement methods were selected, documents each aspect of the calculation and supports the final result. Throughout this process, the administrator involves the public to the maximum extent appropriate.
H. Include all quantified environmental costs and benefits in the decision on resource cost-effectiveness. To compare a resource or measure whose environmental costs or benefits have been quantified in non-monetary terms to other resources, the administrator should begin by comparing its monetary costs to those of competing resources or measures. The administrator should then make the determination as to whether the quantifiable, but unpriceable, environmental effects are sufficient to change the cost-effectiveness ranking of the resource from the ranking based on monetary costs alone.

I. Identify and describe, where no quantification on any terms is possible, the environmental costs and benefits, and assess their probable magnitude in relative terms. The relative ranking of these environmental costs and benefits should be given due consideration by the administrator before the resource is acquired.

New information on the environmental effects of production and use of electricity will continue to appear. This plan cannot anticipate what this new information will be; as it becomes available it should, of course, be taken into account in any evaluation of new resource alternatives. Information that is available now and should be used as a starting point includes: the Oak Ridge National Laboratory studies on fuel cycle externalities, BPA case studies, and Table I-1. Information that is more recent or more accurate for a specific technology or location should, of course, take precedence if it is available.

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Table I-1

Common Environmental Impacts

Technology	Air Emissions					Resources Required		
	tons per gigawatt-hour					tons/Gwh	acres/annual Gwh	
	Total Suspended Particulates	Sulfur Dioxides	Nitrogen Oxides	Carbon Monoxide	Carbon Dioxide	Water	Land Pre-empted	Land use constrained
Small Pulverized Coal[a]	0.20	0.23	1.96	0.20	1184			
Large Pulverized Coal[a]	0.20	0.22	1.93	0.19	1167			
Atmospheric Fluidized Bed (Coal)[a]	0.18	0.21	1.75	0.18	1063			
Integrated Coal Gasifier Combined Cycle[b]	0.04	0.04	0.15	0.02	1322	1409		
Combustion Turbine (Natural Gas)[c]	0.00	0.00	0.16	0.08	606	0		
Combined-Cycle Combustion Turbine (Natural Gas)[d]	0.03	0.02	0.06	0.02	497	1004/ 719[e]		
Combustion Turbine (Oil)[f]	0.17	1.18	0.57	0.64	914			
Combined-Cycle Combustion Turbine (Oil)[f]	0.87	0.87	0.13	0.13	712	1305		
Cogeneration (Natural Gas)	[g]	[g]	[g]	[g]	[g]			
Biomass Steam-Electric (Wood)[c]	0.19	0.93	0.72	1.80	1519 (0 net)	3486		
Cogeneration (Wood)	[g]	[g]	[g]	[g]	[g]			
Municipal Solid Waste (RDF)[a,h]	0.03	0.38	1.71	1.23				
Municipal Solid Waste (Mass Burn)[a]	0.16	0.47	1.54	0.95			1.1	
Nuclear	0	0	0	0	0	3574	0.03	1.1
Geothermal (Flashed Steam)[i]	[j]	.62[k]	[j]	[j]	3[k]	4595	1.2	8.2
Solar Thermal	0	0	0	0	0			
Solar Photovoltaics	0	0	0	0	0	0		
Wind	0	0	0	0	0	0	0.3	20
Hydropower	0	0	0	0	0			
Conservation	0	0	0	0	0			

a SOURCE: Joyner, Michael W., Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards. Compilation of Air Pollutant Emissions Factors: v. 1 Stationary Point and Area Sources, 1985. Coal Gasification Combined Cycle Power Generation G.A. Cremer and C. A. Brigens, Shell Oil Company

b SOURCE: Data gathered by Council staff -- more detail is available from the Northwest Power Planning Council on Excel spreadsheet Q:\JK\EX\DSCOL16D.XLS

c SOURCE: Washington Water Power data on Rathdrum Prairie unit. Unit is GE Frame 7 EA with 925 DLN combustors.

d SOURCE: Data gathered by Council staff -- more detail is available from the Northwest Power Planning Council on Excel spreadsheet Q:\JK\EX\DSNAG86D.XLS

e For closed-cycle cooling

f SOURCE: Bernow and Marron, Tellus Institute, Boston, Massachusetts, *Treatment of Environmental Impacts in Electric Resource Evaluation: A Case Study in Vermont*, January 22, 1990.
g All cogeneration facilities will have fewer impacts than a stand-alone unit, because cogeneration will offset pollutants from another source. Unless the specific fuel and facility being offset is known, the credit to cogeneration cannot be estimated
h Refuse-derived fuel
i H_2S emiisions estimated at .015 tons/Gwh
j We have not found good emissions data for geothermal plants, probably because the effluents are so dependent on the chemistry of the geothermal resource and partly because of an assumption that closed-loop systems do not emit much to the atmosphere.
k These are emissions from CEEI's Coso units, which are thought to be typical.

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