Fraser River Action Plan

Building Full Cost Accounting into Resource Decisions for The Fraser Basin

DOE FRAP 1994-07

Environment Canada Environnement Canada

Building Full Cost Accounting into Resource Decisions for the Fraser Basin

Prepared by:
Tim McDaniels, PhD
Westwater Research Centre
University of British Columbia
Vancouver, Canada V6T 1Z2

February, 1994

Acknowledgements

Work on this study was supported by Environment Canada, through a contract with Westwater Research Centre at the University of British Columbia. I greatly appreciate the interest, encouragement, and helpful editorial advice received from Dr. Sandy D'Aquino of Environment Canada. Craig Roessler, a research associate at Westwater Research Centre, took the lead role in authorship of one of the two background reports prepared for this study.

Executive Summary

This report is concerned with the potential use of full cost accounting as an approach to improve decision making about resource use in the Fraser basin of British Columbia. Full cost accounting (FCA) is an analytical process that involves systematic comparison of all broadly defined costs and benefits when comparing alternatives in planning contexts.

The report begins by introducing the concept of FCA and why it is relevant to Fraser basin planning. Section 2 introduces the kinds of resource decision contexts in which FCA could be applied, stressing different "levels" of decision making and the relevance of FCA to both public and private decisions. Section 3 discusses the central role of values in Fraser basin decisions, within the context of "good decision practice."

The report discusses two alternative analytical frameworks for FCA: social benefit-cost analysis, as practiced by economists, and multiple objective decision analysis, as practiced by decision analysts or policy analysts. The frameworks each involve different approaches to eliciting value judgements through questioning from individuals. The report emphasizes the potential advantages and greater acceptability of multiple objective approaches. Section 5 discusses a hypothetical example that illustrates differences between these two approaches. The last sections discuss an institutional context for FCA and several steps needed for implementation.

This main report is supplemented by two substantial background reports that are available separately. One is a detailed technical literature review of analytical tools for FCA. It discusses the advantages and disadvantages of these analytical tools in some detail. Its title is, "A Critique of Analytical Approaches for Full Cost Accounting," by C. Roessler and T. McDaniels (1994) of Westwater Research Centre. The report is available from Environment Canada. The second report examines the role of multiple objective approaches as a means of creating better, more attractive alternatives for new forestry and energy development questions in the Fraser basin. The specific decision context it addresses is electric utility planning, with a case study of new electrical demands associated with new pulp and paper development in the Fraser basin. The title of the second background report is, "Sustainability, Value Tradeoffs and Electric Utility Planning," by T. McDaniels (1993). It is available from the Centre for Human Settlements, University of British Columbia, in its "Policy Issues and Planning Responses" publication series, or from Environment Canada.

1.0 Overview

The basic message of the recent discussion and writing about sustainable development is that we (western societies) must change how we make decisions involving environmental resources (Clark, 1989; Pearce, 1988; Rees, 1992). One common prescription for making this change is to take better stock of intangible environmental and social values in decisions that normally consider only financial benefits (Ruckelshaus, 1989). This is an extraordinarily difficult task. Environmental and social values mean different things to different people and are not neatly measured in dollar terms. This is also a task that has been around for some time. Over the last three decades, environmental economists have been increasingly concerned with representing intangible environmental values in economic analysis (Mitchell and Carson, 1989). In a separate line of research, decision analysis specialists have also developed methods to tackle all types of value tradeoffs, including environmental and social impacts (von Winterfeldt and Edwards, 1986). Despite these efforts at developing methods, much remains to be done to meaningfully represent environmental values in regional resource planning decisions. How should these complex valuation issues be practically addressed? How should the value information be used to make better decisions? How should institutional practices be structured to encourage innovative evaluation approaches? These questions are rarely discussed in practical terms for regional planning.

This report is concerned with the steps needed to create more informed decision making about resource use in the Fraser River drainage basin of British Columbia. The Fraser basin, a region comprising about 25 percent of the province of British Columbia, is the focus of a unique multi-stakeholder management initiative recently established under the Fraser Basin Management Agreement (Fraser Basin Management Board, 1993). This agreement calls upon the participating governments and organizations to adopt decision making and management systems that "consider social, environmental, and economic costs of all relevant activities and programs." Analysis of social, environmental, and economic costs is often referred to as "full cost accounting," or "social cost accounting," terms used interchangeably, that are drawn from electric utility planning. These terms refer to an analytical process that involves systematic consideration of all broadly defined costs and benefits when comparing alternatives in planning contexts. The potential contribution of full cost accounting in helping to achieve better regional resource decision making seems clear. By broadening the consideration of environmental and social values in resource decisions, we can begin to overcome the focus on only short term, financial concerns. This broader consideration of values can thus encourage

better decisions by users of the Fraser Basin ecosystem, and help make progress towards a sustainable future in the region.

The objective of this report is to consider key issues for making progress towards full cost accounting (FCA) as a basis for important decisions facing groups concerned with resource use in the Fraser basin. Section 2 reviews the decision contexts in which environmental and social values will be important for Fraser basin planning. Section 3 clarifies the role of values (preferences) within the context of what might be generically termed "good decision practice." Section 4 discusses two underlying conceptual approaches for public decisions regarding sustainability issues, which include social benefit/cost analysis (as practiced by economists) and multiple objective analysis (as practiced by policy analysts and decision analysts). This section also discusses the value elicitation approaches associated with these two analytical constructs, which include contingent valuation for benefit-cost analysis, and multiattribute assessment for decision analysis. These are the two approaches available for representing non-market values in analytical terms for FCA. Section 5 outlines the a hypothetical example that illustrates how the two approaches would handle an important issue that would benefit from FCA in the Fraser Basin. Section 6 discusses the institutional context in which FCA might be undertaken, stressing the need to foster integration in evaluation approaches across government agencies. Finally, Section 7 suggests a series of future activities to consider in implementing full cost accounting for Fraser basin planning.

In addition to the main report, two background reports have been prepared to illustrate specific issues associated with FCA in the context of the Fraser basin. One background report provides a detailed critique of analytical approaches for valuing environmental resources (Roessler and McDaniels, 1994). The second background report discusses an issue that will be important for the future of the Fraser basin: the possible development of new pulp and paper conversion facilities in the British Columbia interior, and the implications of these facilities in terms of the requirements for new electrical energy facilities. That report also discusses the implementation of sustainability concepts by large organizations, such as electric utilities (McDaniels, 1993). The background reports

are written as separate, stand-alone documents that are available from Environment Canada. The second report is also available from the Center for Human Settlements at the University of British Columbia.

2.0 Kinds of Decisions

Broad environmental and social values are clearly relevant for, and influenced by, public decisions made by governments as well as private decisions by individuals and organizations. Both types of decisions are therefore potentially important contexts for FCA. Public policy decision contexts are considered first.

The strategic plan for the Fraser basin management program outlines several resource areas where specific public sector management strategies will be required. These include water resources, land resources, and waste management issues (Fraser Basin Management Board, 1993). Decisions by the FBMB in each of these areas are likely to focus on two issues:

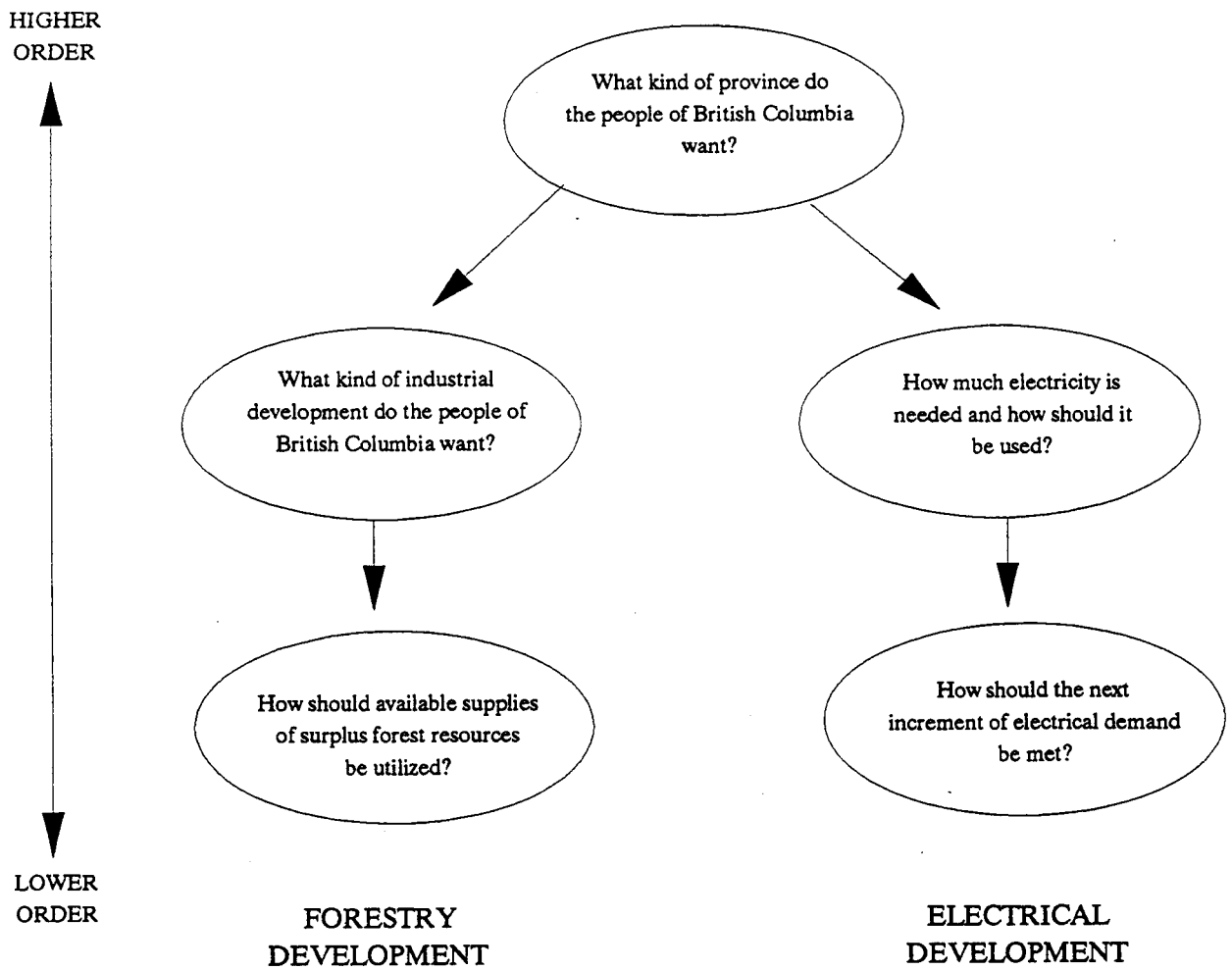
(1) What are the best possible uses for the natural resources in question?

(2) How can the consequences of economic activities best be managed to minimize adverse effects on other resources?

These policy questions could be pursued at various levels, ranging from the strategic to the detailed. An example of the strategic level would be an overall vision for the future of the region which would serve as the basis for many kinds of more detailed planning activities. An example of a detailed implementation question would be the choice of the most appropriate waste management technology for an industrial facility. Sustainability debates can benefit from recognition of the links between these levels, so that one is "asking the right questions" for a given policy decision. William Clark, in a recent *Scientific American* article (1989), stresses two fundamental questions for sustainable development: "What kind of planet do we want, and what kind of planet can we get?" Figure 1 illustrates the role of these questions in the context of a hierarchy of decisions regarding the use of forest resources in the Fraser basin. A lower order question commonly asked by resource planners is: "How shall available supplies of forest materials be used?" Influencing the answer to that question is "What kind of industrial development do the people of British Columbia want in the interior of the province?"

Figure 1

Hierarchy of Questions Regarding Forestry and Electrical Energy Development in British Columbia



The most fundamental question of all is, "What kind of province do the people of British Columbia want?" A similar hierarchy of questions is shown in Figure 1 for electrical development. A background report (entitled "Sustainability, Value Tradeoffs and Electrical Planning") discusses in more detail the development of new pulp and paper conversion facilities in the Fraser basin (McDaniels, 1993).

FCA could be used to help address both the higher and lower order questions outlined in Figure 1. For higher order questions (e.g., "What kind of Fraser basin do the people of British Columbia want?"), FCA would involve a process through which people could articulate values by thinking about, constructing, and selecting among long term alternative futures. This is "strategic planning" at a very broad, societal level, involving whole regions rather than one organization or community. One method that could be employed in such efforts has been termed "backcasting," in which groups consider the kinds of futures they would like to achieve and use these visions as a basis for constructing policies to achieve them (Robinson, 1982). Scenarios could also be developed that emphasize specific policy levers available to governments (e.g., levels of forest harvests) that serve as a basis for defining possible futures. Still another approach would be to focus explicitly on the fundamental values important to various groups for addressing the fundamental questions of the kind outlined in Figure 1, and then using the value information to help construct new, more attractive alternatives (Keeney, 1992).

The lower level policy decisions of Figure 1 are contexts in which more familiar notions of FCA could be employed. FCA in decisions of this nature would entail efforts to quantify the broadly defined societal costs and benefits of policy alternatives to help make informed public policy choices. FCA should involve both a process for structuring such public decisions, and for representing the values people associate with environmental and social impacts when comparing alternatives.

The context in which this more quantitative version of FCA would be important are those noted earlier as crucial issues for the Fraser basin: land use, water use, and waste management. For example, what specific areas of the Fraser basin land base should be devoted to forestry, mining, agriculture, urban development, wilderness preservation, or mixed uses? How should water resources be allocated among fisheries, power generation, irrigation, or urban water supply? How should the residuals from industrial and urban activity be managed? Each of these contexts involves countless specific decisions in which FCA should be employed.

FCA could also be relevant for environmentally important private decisions, which are decisions by individuals and organizations that affect environmental quality. Sustainable development writing discusses three types of changes in private decisions affecting environmental resources which could be fostered by FCA. One change is the need for consumers to make more informed choices in their everyday consumption habits, ranging from commuting patterns to grocery purchases. Environmental education, information about the impacts of consumer goods, and higher prices for environmentally harmful substances are all discussed as approaches to encourage a more informed basis for environmental choices by consumers (Ruckelshaus, 1989). A second change involves large corporations, particularly those with resource or industrial-based businesses. Here writers stress the benefits of developing production processes that minimize wastes, as well as the need for a fuller understanding of the lifecycle impacts of product use and disposal (Jackson, 1993). A third change, related to the previous two, is the potential role of economic instruments in shaping environmental decisions. Stavins and Whitehead (1992) discuss the potential benefits of economic incentives in detail, emphasizing that appropriate pricing can be effective in changing economic behaviour. In each of these areas, the concepts of FCA could be important influences on private decisions.

Even though these private decisions will be crucial in shaping environmental futures, the focus in this report will be on public policy issues, for three reasons. First, public action will be needed as a precursor to changing private behaviour. For example, policy decisions would be required in order to undertake environmental education, provide information to consumers about the environmental impacts of products, or make substantial decisions about commodity and resource pricing. Second, private organizations will rarely find it in their interests to pursue social costing without some imposed regulatory mandate or public scrutiny. While it is true that many firms undertake environmental audits and redesign their production processes to minimize waste, the impetus for these activities has many sources, including compliance with regulations, avoiding liability, minimizing costs, and being a good corporate citizen. Consequently, regulatory contexts are the areas in which governments can most readily affect behaviour by corporations. Third, regulatory processes are typically the contexts in which resources are most likely to be available for FCA activities, from both government and the private sectors.

The remainder of this report focuses on government resources policy and regulatory contexts of governments as opportunities for applying FCA. As noted earlier, the policy areas in which FCA principles are most relevant for the Fraser basin include land use, water use, and waste disposal. From this list one can draw a number of potential case

studies that could serve as a basis for experimentation regarding FCA. Examples could include the appropriate level of wilderness preservation and forest development in areas such as the Cariboo-Chilcotin, the allocation of water between alternative uses in arid areas of the Fraser basin, or pulp and paper waste water management in the Fraser River. Each example would provide opportunities to test and apply FCA approaches discussed in subsequent sections.

3.0 Values in Fraser Basin Decisions

3.1 Values In Good Decision Practice

For the purposes at hand, values might be generically defined as "what we care about." [1] Values explicitly or implicitly serve as the motivation for actually making any decision, and also serve as the basis for selecting among available alternatives for the decision. Given the importance of values for decision making, it is remarkable how little effort typically goes into clarifying the full range of values important for a given decision (Keeney, 1992). Hence the need for efforts to implement FCA. It will be useful to clarify the role of values in decision making generally in order to determine how values can be effectively used to clarify Fraser basin resource decisions.

One can draw on the extensive literature on decision making to identify a sequence of steps that comprise an orderly approach for all kinds of decisions, including those in which FCA could be applied. The steps are summarized in Table 1.

---

1 There is a huge literature in the social sciences, including ethics, psychology, and economics, on the concept of value. Roessler (1993) provides an excellent synthesis of this literature as a basis for preference elicitation in FCA for wilderness preservation.

Table 1
Steps in Good Decision Practice

(1) Identifying the specific decision that must be made.

(2) Clarifying the underlying objectives or "important considerations" that are important to be achieved in making this decision.

(3) Identifying the alternatives to be considered.

(4) Determining the impacts the alternatives will have on the underlying objectives (from step 2).

(5) Evaluating the attractiveness of the impacts of the alternatives.

(6) Selecting a preferred alternative (Keeney, 1980).

Steps similar to those in Table 1 could be drawn from a wide range of authorities on decision making, including Benjamin Franklin, Edward de Bono, and Kepner and Tregoe. The specific steps listed here are drawn from an overview of decision analysis (Keeney, 1982). The steps in the table could also be described as good planning practice, in that they closely follow a sequential approach to planning identified in that field (Boothroyd, 1991). In sum, these are generic steps in any structured approach to employing FCA for resource policy decisions.

The steps in Table 1 also provide a basis for distinguishing between technical information (facts) and preference information (values) in decision making practice. Some would argue that "values" might influence choices at each step in Table 1. In our view, value judgements by individuals are most relevant in steps 2 and 5. Step 1 is a matter of structuring the problem to identify the appropriate decision at hand, which involves judgements such as which decision level in Figure 1 is appropriate for a given policy question. Steps 3 and 4 largely involve technical information, since identifying alternatives that could be technically feasible and identifying the impacts of those alternatives are technical issues that require engineering, science, and modelling. Of course, what is viewed as a "fact" in each of these step may be shaped by value orientations of the individual involved. Nevertheless, there is a core of technical knowledge that is important in determining the appropriate content for each step. Conversely, the steps associated with defining objectives and defining priorities among objectives are explicitly value-relevant questions. Recognizing that (1) the choice of the criteria, or objectives, that should matter in a decision involves value judgements and (2) that tradeoffs among

objectives are inevitably required in all complex problems, are two important insights needed to create informed decision making and successful FCA.

The kinds of objectives likely to be important to decision makers and stakeholders in Fraser basin planning are reasonably easy to identify. *Minimizing environmental impacts* of economic activities is clearly an important social value, as evidenced in the regulatory requirements for environmental impact assessments, and the clear voices calling for attention to environmental concerns in writing on sustainable development. Concerns about *minimizing adverse social impacts* and *maximizing beneficial social impacts* are also common values for a wide range of decisions facing planners in the Fraser basin. Finally, economic concerns, including *minimizing costs of building facilities* and *maximizing economic benefits* such as income and employment, are clearly relevant for decisions in the Fraser basin. There will undoubtedly be several additional objectives that are relevant for specific kinds of decisions regarding the Fraser basin. A careful approach to Step 2 in Table 1 would therefore require extensive interviews and consultation to ensure that a well structured, comprehensive set of objectives is at hand. Edwards and von Winterfeldt (1987) provide useful examples of how objectives can be structured in multi-party resource planning questions.[2] One example they describe involves conflicts over off-shore oil drilling in California, and a second involves water allocation in Arizona. Both examples involve efforts to represent the objectives of different interest groups as a means of facilitating communication, diagnosing conflict, and creating more attractive alternatives.

Technical information is also an important component of good decision practice. The explicit technical questions in Table 1 include Steps 3 (creating alternatives) and 4 (identifying the impacts of alternatives). These steps are familiar to engineers and impact assessment specialists, so they need not be discussed in detail here. Nevertheless, it is important to stress that creating attractive alternatives often requires thinking about new, innovative ways to achieve objectives at lower cost, such as substituting demand management for investment in new capacity (Crown Corporations Secretariat, 1993).

---

[2] Once objectives are established, the next task is to set priorities among them. The basic question that must be addressed might be characterized as, "How much performance on objective A are you willing to give up to get a stated improvement in performance for objective B?" This question focuses clearly on tradeoffs, which is the key information needed for FCA. In the words of Ruckelshaus (1985), "we cannot avoid asking 'Is it worth it'?" We cannot avoid the difficult introspection needed to decide whether a given increase in, say, costs, is worth the resulting potential improvement in environmental quality, or whether a given reduction in environmental quality is justified by the resulting economic benefits.

Using the value information can be extremely important in creating attractive alternatives (Keeney, 1992). A second point is the need to be explicit about uncertainties, often with probability, in order to fully characterize impacts. Gregory, Keeney and von Winterfeldt (1991) discuss several ways in which impact assessment can be improved by the explicit use of good decision making practice, which include characterizing a complete set of objectives, using creativity to develop new alternatives, and characterizing uncertainties about impacts.

3.2 Mediated Processes and FCA

One might wonder about the relationship between the activities outlined in Table 1, referred to here as good decision making practice, and mediated stakeholder processes which are widely seen as a desirable basis for environmental decisions in British Columbia and elsewhere. These two approaches have many similarities, yet are different enough that they could be placed at opposite ends of the decision making spectrum. One similarity is that both approaches require input from stakeholders about what is important to them. Second, both approaches should ideally focus on interests rather than positions as a means to making insightful choices. Important differences are that "good decision practice" outlined in Table 1 starts with the assumption that there is a specific institutional framework for making public decisions. The framework, which would range from a regulatory body to the provincial Cabinet, might be viewed as the decision maker for the policy question at hand. The purpose of the process outlined in Table 1 is then to provide a well structured decision with relevant information about the values of key groups, as well as relevant technical information, to allow the decision maker to make a wise choice among the alternatives. In contrast, mediated processes generally treat a stakeholder group as the decision making body. The purpose is to foster a consensus-based solution to a public decision, in which there is often a wide range of viewpoints and a great deal of controversy. In practice, mediated processes work hard to resolve conflicts among stakeholders through the process itself. Often there is less time and effort devoted to effectively structuring objectives and alternatives, or using technical information about the consequences of alternatives. In sum, the approach outlined in Table 1 emphasizes getting value information from stakeholders to use for public policy decisions by governments. Mediated processes view themselves as the decision making body and the emphasis is largely on conflict resolution rather than good planning.

Some might argue that this characterization is unkind to mediated processes. Ideally, mediated processes could adopt versions of the steps used in Table 1 as a basis for

defining a decision faced by the stakeholder group, clarifying differences in values and using technical information to describe the impacts of the alternatives. Recently, Keeney (1992) introduced the concept of "value-focused thinking" as an approach to using the kinds of value information shown in Table 1 for creating better decision practice, which could in turn facilitate consensus building. Value-focused thinking starts with identifying objectives important to stakeholders in a given decision. This information can be used to diagnose conflicts among stakeholders and anticipate opposition to change by pointing winners and losers associated with alternatives. The information is also important for structuring technical analysis by providing measures for key variables and by distinguishing between value-relevant and factual dimensions of the question (Gregory, Keeney and von Winterfeldt, 1992). Value assessments from the viewpoint of stakeholder groups can be used as basis for inventing new win-win opportunities by looking for ways to mitigate or compensate for adverse effects that are not too costly to others (Keeney, 1992), in the same spirit as the role of a mediator in a multi-party decision process. Thus, the steps in Table 1 could comprise an analytical structure to complement and enhance mediated stakeholder processes, by providing a decision framework for "negotiation analysis" (Sebenius, 1992) to facilitate consensus.

4.0 Alternative Public Decision Frameworks and Value Measures

FCA might be defined as an analytical comparison of all benefits and costs, including environmental and social benefits and costs, for an environmentally important decision, to provide an insightful basis for informed choice. This clearly requires prescriptive analysis, oriented toward making better decisions, yet the writing on FCA is often vague on exactly how this prescriptive analysis should be conducted, especially on how benefits and costs are to be quantified and compared (Ruckelshaus, 1989).

There are two distinct approaches that could be considered as conceptual frameworks for FCA: social benefit-cost analysis, as practiced by environmental economists, and multiple objective decision analysis, as practiced by policy analysts and decision analysts. Social benefit-cost analysis (SBCA) is probably the more widely known approach, and in the United States is viewed as the mainstream approach, particularly in legal and regulatory contexts. In contrast, multiple objective analysis is the more broadly based approach (SBCA could be subsumed in it). It involves more direct and

well-structured public input and it is likely to be more appealing as a basis for decisions. The basic steps and analytical steps for valuation associated with these two approaches are discussed in the remainder of this section. We review these approaches in some detail, particularly the methods they use for preference elicitation, because understanding their differences is crucial for making informed choices about good practice for social cost accounting. As will be seen, multiple objective decision analysis is recommended here as a better framework for representing environmental and social values for resource decisions, although there are caveats to consider.

4.1 Social Benefit-Cost Analysis

Conceptual Framework

Social benefit-cost analysis (SBCA) is an applied version of welfare economics (Mishan, 1981). It is a public sector analytical framework that is superficially similar to financial cash flow analysis. One important difference is that SBCA is intended to determine societal "profits," or economic efficiency gains, from the viewpoint of the overall economy or society as a whole. It is concerned with identifying economically efficient resource allocation choices that create benefits to society by using resources more effectively. A second difference is that SBCA is concerned with valuing all market-oriented and non-market effects of a policy of resource allocation, while financial analysis is only concerned with real dollar flows. All values in SBCA must be measured in dollar terms: values associated with new opportunities created by a policy are measured by consumers' willingness-to-pay (WTP), while the values of opportunities foregone are measured by resource owners' willingness-to-accept compensation (WTA). An analysis is conducted from the perspective of the overall society, usually a referent group within political boundaries, such as from the viewpoint of the citizens of a province or nation. Mishan (1981) and Smith (1986) provide extensive discussion of the conceptual foundations and applied practice for SBCA.

An important question for SBCA is how to deal with values for non-market goods that are not conventionally measured in dollars. For example, how might one place dollar values measuring people's WTP or WTA on unfamiliar, poorly understood goods such as wilderness preservation, visibility, or safety? SBCA has developed two approaches to address such questions: expressed preference measures (based on asking people questions) and revealed preference measures (based on observing behaviour) (Fischhoff and Cox, 1986).

Difficulties with SBCA

Several conceptual and practical difficulties with SBCA are outlined below.

(1) *Single objective focus.* SBCA is oriented toward analysis of a single objective: economic efficiency. All changes in societal well-being are valued in terms of net economic benefits that could be created. This perspective fails to recognize that there is a wide range of objectives important in public policy questions, other than economic efficiency. For example, the objectives noted earlier of minimizing adverse environmental or socioeconomic impacts are not directly considered in this framework. They are only considered to the extent that the values can be monetized.

(2) *Lack of consideration of winners and losers.* SBCA deliberately avoids examination of who obtains benefits and who pays costs associated with a policy. Rather, it depends on an analysis from the viewpoint of the society as a whole as the best overall perspective on such questions because of the lack in economics of a framework for comparing gains and losses among individuals. This focus on aggregate net benefit raised two concerns about SBCA. First, there is no attention to the equity of possible changes, in terms of who benefits relative to who pays. An extreme example would be a resource policy change that benefits a small group (such as the shareholders of a company) at the expense of everyone else in a region. Such a change would be viewed as beneficial in SBCA if the values to be gained exceeded the values to be lost. The second concern stemming from the focus on aggregate net benefits is the lack of attention to the political economy of resource decisions. Effective implementation of policies requires an understanding of how existing institutional structures and powerful interests would be affected by policy changes. It also requires a means for addressing possible objections of powerful economic and institutional interests through creation of more attractive win/win alternatives. A background study for this report discusses the need for more attention to the political economy of resource use changes in order to achieve effective implementation of sustainability concepts (McDaniels, 1993).

(3) *Ethical concerns.* Kelman (1981) raises several ethical objections to SBCA. Most important is the need to monetize values that are not well registered in dollar terms. Another concern is the underlying utilitarian viewpoint, which

emphasizes aggregate net benefits as the appropriate measure rather than paying attention to the distribution of net benefits.

(4) *Discounting.* SBCA uses the concept of a "discount rate" to value effects over time. A discount rate is an interest rate used to express the value today of a stream of payments (benefits or costs) stretching into the future. Use of a discount rate draws on financial concepts to prescribe how we should treat effects that happen over time in public sector analysis. The difficulty with this approach is that it places a strong bias against attention to the interests of future generations in public section analyses. With discount rates in the realm of 8%, impacts that occur about 40 years in the future count for very little in a benefit-cost analysis. This approach runs counter to much of the writing on sustainable development, which argues for more equitable treatment of how we deal with future generations.

Contingent Valuation

Because FCA is directly concerned with valuing non-market resources, the conceptual basis and applied practice of contingent valuation deserves discussion. Contingent valuation asks people to provide direct expressions of preferences for non-market resources by indicating what they would be willing to pay for a benefit, or what they would be willing to receive in compensation to accept a loss for a hypothetical scenario regarding a change in a non-market good. Benefits and costs are presented as increments as decrements in the quality or quantity of specific non-market resources. The elicitation procedure is called contingent valuation because the elicited WTP (or WTA) are "contingent" on the specific hypothetical market described to the respondent (Mitchell and Carson, 1989). Mitchell and Carson describe a typical contingent valuation, which generally consists of three parts:

(1) a detailed description of the good(s) being valued and the hypothetical circumstances under which it is made available to the respondent;

(2) questions which elicit the respondent's WTP for the good(s) being valued; and

(3) questions about the respondent's characteristics (for example, age, income), their preferences relevant to the goods being valued, and their use of the goods.

Contingent valuation is conducted as a written survey or a direct interview. Several kinds of questions have been employed, including open-ended questions ("How much are you be willing to pay...?"), an iterative bidding method, a method involving payment cards, or the dichotomous choice method which asks for a yes/no answer to a WTP question ("Would you be willing to pay $50 for...?"). Mitchell and Carson (1989) discuss these methods in detail.

The advantage of contingent valuation is its flexibility. Questions can be developed to elicit values for any type of non-market resource problem. Questions can also be structured to address values that arise in direct use of the resource (e.g., fishing) or values that arise from simply knowing that the resource exists or that it should be left for future generations (Mitchell and Carson, 1989).

There are also drawbacks with contingent valuation. The most fundamental weakness is the insistence on market-based dollar measures to represent what may be deeply held values, as rich and multi-faceted as those held for ethereal concepts such as freedom, or religion, or family (Brown, 1984). Recent research stresses that people's values for environmental goods are inherently multi-dimensional and are not well represented in a single dollar figure (Gregory et al, 1992). Another difficulty with contingent valuation is the underlying assumption that people have well defined values for non-market goods such as environmental quality buried within their consciousness. From this perspective, the task of contingent valuation is to ask effective questions to ferret out this well defined value. However, a wealth of psychological research on preference elicitation and decision making stresses that people do not have well defined values in their heads for goods that are not familiar or that are not normally viewed in terms of markets. Values for these goods are likely to be poorly defined, highly changeable, and easily influenced by the way valuation questions are asked (Fischhoff, Slovic and Lichtenstein, 1981).

Several other difficulties have arisen in the context of contingent valuation efforts. One concern has to do with the validity and reliability of contingent valuation studies. Several authors have subjected the results of contingent valuation to standard tests of reliability and validation. Such tests have proven difficult and often inconclusive about whether the results are meaningful (Reiling et al, 1990; Kealy, Montgomery and Dovidio, 1990). Another area of concern is the discrepancy between WTP and WTA measures of value. Economists often argue that there should be little difference between people's willingness to pay for purchase of a good and the amount for which they would sell the same good, yet many empirical studies have shown a substantial discrepancy between these two

value measures within a contingent valuation framework, or even in straightforward experimental contexts involving real goods (Knetsch and Sinden, 1984). The discrepancy between WTP and WTA values is a serious problem with contingent valuation because many studies have shown disparities with, WTA values three to five times greater than WTP values. The choice between these two value measures is difficult to make on conceptual and practical terms. Either could be used in many evaluation contexts, depending on whether changes are viewed as losses or gains. Another criticism of contingent valuation is its potential for biases, including those associated with questionnaire design, and motivational biases or cognitive biases. The background paper concerned with analytical approaches reviews these biases in detail.

4.2 Multiple Objective Decision Analysis

"Decision analysis" refers to a conceptual framework, a set of techniques, and a process for obtaining insight into complex decisions. Keeney provides an intuitive definition of decision analysis as "a formalization of common sense for decision problems which are too complex for informal use of common sense." A more technical definition is "a philosophy, articulated by a set of logical axioms, and a methodology and collection of systematic procedures, based upon those axioms, for responsibly analyzing the complexities inherent in decision problems" (Keeney, 1982).

Decision analysis is not a new approach, even though it may not be as familiar as SBCA. The conceptual basis and applied practice of decision analysis has expanded dramatically since the mid 1960s and many examples of decision analysis applications have been published. For the purpose at hand, the approach can be viewed as a process involving four components, as briefly noted below:

(1) *Structuring the decision.* Key steps include defining the specific decisions to be made, identifying a wide range of effective and creative alternatives, and specifying objectives that are important in selecting between the alternatives.

(2) *Assessing possible impacts of alternatives.* Most conventional financial, engineering, and environmental studies undertaken to investigate resource management questions could be viewed as partial components of this step. Decision analysis places special emphasis on representing uncertainties regarding impacts of alternatives through the use of probability. The impacts of interest are defined by the objectives that are important in selecting between alternatives.

(3) *Determining preferences (values) of decision makers.* Understanding preferences is crucial to informed decision making and is uniquely addressed in the decision analysis approach. The process begins with a compact, complete statement of objectives important for a particular decision, as would be forthcoming from step (1) above. Next, attributes (operational measures of performance) are defined to provide a basis for analyzing how alternatives perform. Tradeoffs between objectives are investigated with constructive elicitation procedures, from which a value or utility function (i.e., a mathematical representation of the tradeoffs that decision makers view as appropriate between objectives) is developed. If many stakeholder groups are important, then different value functions can be defined to quantify the diversity of views.

(4) *Evaluating and comparing alternatives.* Emphasis is placed on gaining insight into the differences between alternatives. Comparisons are made on the basis of expected value or utility; probabilities and values are considered separately, and then integrated in the analytical framework. The analysis is iteratively refined, and the merits of further data collection are assessed.

These steps are identical to, and are drawn from, the same source as the steps for good decision practice in Table 1 (Keeney, 1982). While a complete decision analysis would involve a quantitative treatment for all these steps, considerable insight can often be gained by partial analysis involving one or two steps and qualitative probing. For example, the British Columbia Crown Corporation Secretariat recently released its *Guidelines for Multiple Account Analysis* (1993), which are intended to encourage multiple objective public sector analysis by provincially-owned corporations. These guidelines ask analysts to complete the first two steps in the list above. Then decision makers in government have the responsibility to provide their own judgements about the relative desirability of alternatives based on an "objectives by alternatives" matrix summarizing the first two steps.

Multiple objective decision analysis is not subject to the same kinds of ethical and procedural criticisms as directed at SBCA because the approach can be adopted to virtually any ethical perspective (Keeney, 1982). The decision analysis process begins by clarifying a decision to be made and then characterizes the broadly defined objectives relevant for that decision. It is the rigid definition of a single objective (economic efficiency, in utilitarian terms) that leads to the ethical criticisms for SBCA. It is the flexibility to define objectives in any way that a particular individual or group desires

that leads to a wider range of applications and greater acceptance of multiple objective decision analysis.

Decision analysis does not require that values for non-market goods be measured in dollars. The measures for, say, biophysical objectives can be cast in "natural" units such as hectares of land or number of animals, and economic objectives can be cast in dollars or jobs. Tradeoffs between objectives, such as how much of one objective (say, dollars) an individual believes it is appropriate to give up to obtain gains on another objective (say, number of animals), can then be explored and quantified. Another important distinction is that these tradeoffs are not cast in terms of individual WTP, as in SBCA. They are cast in terms of tradeoffs that participants view as appropriate for, say, government to make on society's behalf. Thus, the valuation question is more in line with the concept of a vote than an individual market transaction.

The value elicitation procedures of decision analysis can rigorously address the fundamental question "Is it worth it?" for environmental decisions. The procedures typically begin by identifying stakeholder groups and holding meetings to determine what each group believes is important in a given environmental decision. These perspectives can then be structured into an objectives hierarchy that contains a complete list of factors (objectives) relevant from the viewpoint of all groups. Attributes or performance measures are then defined for each objective, and value or utility functions developed to reflect the preferred tradeoffs of each stakeholder group (Keeney, 1988). In practice, simply structuring objectives and identifying differences between groups are key steps in building communication, diagnosing conflicts and fostering negotiation. Edwards and von Winterfeldt (1987) provide revealing examples of multiple objective structures for risk management choices involving many stakeholders.

Uncertainties are explicitly represented in decision analysis through the use of probability. Probabilistic information can be drawn from a variety of sources, including historical data, operations research modelling, subjective judgements by experts, or a combination of sources. Probabilistic models can then be constructed to represent the influence of various sources of uncertainty upon the choice between alternatives (Morgan and Henrion, 1990).

Uncertainties and values can be integrated with the axioms of decision analysis, which are principles for analyzing decision problems. In simple terms, the axioms imply that the attractiveness of alternatives should depend on: (1) the likelihoods of the possible

consequences of each alternative, and (2) the preferences of decision makers for those consequences. The axioms imply that all decisions require subjective judgements. Judgements about the likelihoods of specific outcomes and the desirability of those outcomes should be separately addressed using probabilities and utilities, respectively. Probabilities and utilities can then be used to calculate the expected utility of each alternative; alternatives with higher expected utility should be preferred (Keeney, 1982).

Social Decision Processes and Institutional Change

Decision analysis has many features that make it particularly appropriate for gaining insight into environmental choices in social decision contexts. The subjective components of values, in terms of stakeholder views regarding environmental tradeoffs and intergenerational issues, can be considered explicitly and coherently. There is a clear structure in which values are linked to measurable attributes, and preferred tradeoffs between attributes can be quantified. Stakeholders can be asked what they consider to be important, how these important objectives should be measured, and the tradeoffs they view as relevant between other important aspects of the problem. By addressing the views of stakeholders explicitly and clearly, the decision process takes on more openness. It also provides an analytical framework within which the results of "public involvement" can be structured and applied. The result is greater insight to those who have to make the ultimate decisions within the existing institutional context.

The decision analysis process also facilitates informed public debate. An explicit framework is developed in which decisions are clearly represented as a series of steps, and the distinction between values and facts (or uncertainties regarding facts) are clearly represented. Consequently, public debate can focus on those aspects that are more important: the adequacy of existing technical models, the implications of uncertainties regarding impacts, and the value judgements regarding the relative significance of impacts. Informed public debate in turn leads to better understanding of the real differences in viewpoints between groups. This understanding is a key step in considering ways in which those who would gain could compensate those who would lose in order to lead to more widely supported outcomes. Mechanisms of this nature are crucial in successfully implementing change in resource use patterns.

Finally, these points also make decision analysis an appealing tool for helping to encourage change in existing institutional structures. The collective environmental decisions of interest here will largely be made within the governing structures now in

place and subject to the political and economic pressures now at work. Perhaps the best way to reshape decisions by these institutional structures is with an approach to decisions that demonstrates the implications of alternative choices, provides a clear structure for integrating facts and values, reflects alternative public perspectives, and encourages a search for "win-win" solutions (Gregory, Keeney and von Winterfeldt, 1991).

When considering prospects for successful implementation of this decision analysis, it is important to recognize that the requirements of this approach are not radically different from the kinds of analysis done now for environmental or resource decisions (such as financial analysis, engineering studies, environmental impact assessments, and social benefit-cost analysis). Rather, decision analysis provides an overall framework within which these partial analyses (that typically address only one objective within a complex problem) can be integrated. Decision analysis is not a radical new tool, but a meta-framework that first disaggregates a decision into logical components, then assembles the parts into an insightful whole. Perhaps the most radical aspect of decision analysis is that it involves explicit elicitation of value judgements that are not common in other approaches, but are nevertheless important parts of the problem at hand.

Comparison with SBCA

Much of the writing concerned with environmental economic analysis of sustainable development decisions argues in favour of a conventional social benefit-cost analysis approach, augmented with sustainability constraints (see, for example, Pearce, Markandya and Barbier, 1989). We noted earlier some of the objections raised about SBCA, including its single objective structure, its requirement for market-like information in dollar terms, and difficulties with contingent valuation. How does multiple objective decision analysis compare to SBCA?

A multiple objective structure, as provided by decision analysis, is a richer, more defensible basis for contemplating environmental tradeoffs. The elicitation approaches for structuring tradeoffs can be more directly tied to the decision context. They do not require market-like dollar measures as the basis for value tradeoffs, and involve an analyst and a decision maker in a constructive process for structuring and clarifying values, rather than simply measuring them. In loose terms, one could cast decision analysis as an expanded form of benefit-cost analysis in which objectives are multi-dimensional, elicitation procedures for value tradeoffs are more defensible, the implications of differences between stakeholder values can be explored, uncertainties are more

carefully represented, and more attention is paid to problem structure and decision process.

One aspect of social benefit-cost analysis that is particularly controversial for resource and environmental evaluation is the discounting of benefits and costs over time. Discounting is the practice of systematically placing less value on effects that occur further in the future, on the basis of a social discount rate or social rate of time preference. This approach has important implications for decisions with long term consequences, as do all those associated with environmental choices (Pearce, Markandya and Barbier, 1989). It is important to recognize that discounting involves strong assumptions and rather rigid prescriptions regarding how society should approach questions involving values over time. In contrast, decision analysis recognizes that the relative importance of impacts occurring over time is a value judgement, open to differences in views among decision makers, and not simply a parameter to be looked up in a guide book. It is legitimate to consider that different values for effects over time could exist for different time periods, for different resources, or for different decision makers. Keeney (1980) provides a discussion of the conceptual foundations of various approaches to valuing impacts over time and examples of how these approaches are handled in decision analysis.

One objection sometimes levelled at decision analysis is that it presumes a single decision maker, and thus is irrelevant for public policy decisions involving many potential sets of decision makers and stakeholders. On the other hand, social benefit-cost analysis does not presume a single decision maker, but instead adopts a social decision rule based on utilitarianism: a particular change in resource allocation is judged to be beneficial if the aggregate benefits (measured on the basis of WTP) exceed the aggregate costs (measured on the basis of WTA), irrespective of the distribution of benefits and costs. Thus, it is argued that social benefit-cost analysis is a more conceptually appropriate basis for public choice because it has a clear decision rule.

This criticism of decision analysis is unfounded, both conceptually and practically. Kirkwood (1979) and others have discussed the conceptual structure of "social" decision analysis, in which decision makers hold utility functions over the interest of relevant stakeholder groups, thus providing a theoretical framework for such choices. From a practical perspective, decision analysis can be illuminating for public decisions if one accepts that the objective of analysis should not be to reveal the "right answer" (which is never achievable), but to provide insight. Great progress can be achieved in public

decisions by clarifying the objectives relevant to different groups and the importance they place on different objectives. Thus a particularly insightful "values model" for a social decision would represent the preferences of various stakeholder groups to determine how sensitive the choice between alternatives is to differences in viewpoints.

A final advantage of decision analysis is the emphasis on formulating decision strategies to respond to uncertainty. For example, the value of collecting new information in complex decisions is an important concept in decision analysis. Similarly, decision analysis pays careful attention to the timing of decisions and relationships between sequential decisions as a means of responding to uncertainty. Adaptive management approaches involving structured management experiments to provide information about environmental systems are firmly rooted in decision analysis (Walters, 1986). Finally, highly complex and uncertain global issues, such as the value of biodiversity or policy responses to climate change, could be insightfully explored using a decision analysis framework for managing risks.

Disadvantages of Decision Analysis

There are some disadvantages to decision analysis for FCA that should be addressed. First, a complete decision analysis of an environmental decision, involving structuring the decision, creating quantitative utility functions, and modelling the consequences of alternatives, would require considerable effort and specialized knowledge. Although the level of effort and knowledge is not dramatically different from that required for conducting an SBCA, the orientation is different.

Second, the questioning processes used to elicit the value tradeoffs needed to build utility functions can be complex for those interviewed and demanding for the analyst. On the other hand, simplified versions of multiattribute value elicitation, such as SMART (simplified multiattribute rating technique) can be employed. These methods (see von Winterfeldt and Edwards, 1986) can be used with individuals or groups, and provide a manageable approach to value elicitation using straightforward "rating and weighting" methods.

Third, relatively few people are familiar with decision analysis approaches for environmental evaluation. SBCA is more widely taught and there are more practitioners.

5.0 A Hypothetical Example

The previous section outlines alternative conceptual approaches for full cost accounting. In this section, a hypothetical example is presented to illustrate the differences in how the approaches would be applied in practice. The policy context for this example is the potential development of new pulp and paper mills in the interior of British Columbia. McDaniels (1993), a background paper for this report, indicates there is potential for development of several new pulp and paper mills in the interior of British Columbia that would utilize supplies of lower quality softwoods, hardwoods, and mill residues that are not presently utilized. If new pulp and paper mills were to be developed in the interior, they would likely use the chemothermomechanical (CTM) pulp process rather than the kraft process, which has significant implications for the long term sustainability of the industry. The CTM process has many factors that make it attractive for new pulp and paper development: it is highly efficient in that is gets about twice the pulp and paper output from a tonne of wood input as does the kraft process; it has lower water emissions because it does not necessarily utilize chlorine bleaching; and the mills can be smaller scale so they can more readily fit into community economies. One major drawback of these mills is that they have about twice the total electricity requirements and five times the purchased electricity requirements of a kraft mill. Thus, new pulp and paper development with the CTM process creates substantial indirect demands on the electrical infrastructure in British Columbia. Forecasts as of 1990 indicate that new pulp and paper development could account for as much as 23 percent of the growth in electrical demand in British Columbia from 1990 to the year 2000. In addition, increases in forest harvests could exacerbate conflicts over the effects of commercial forestry on wilderness preservation, particularly if areas for new pulp harvests are not identified with environmental constraints in mind.

In sum, development of new pulp and paper facilities in the Fraser basin carries several major questions associated with sustainability issues. These include the appropriate rate of harvest and the degree to which additional harvests would impinge upon areas that might also be valuable for wilderness protection; the implications of the additional processing facilities for electrical demand; and the types of effluent controls for air and water emissions that should be required for such facilities.

These questions could be considered as part of an overall review of regional development strategies, where social costing could, at one level, be described as high level regional planning. Conversely, a more likely approach would be that the potential

impacts of the new facilities might be considered as separate questions with no integration. Figure 1 illustrates the levels in which these questions might be addressed. The best approach for handling such large scale questions with implications in many sectors would be to begin with high level regional planning and use the answers to those fundamental questions as influences on the lower level questions. The following subsections discuss how benefit-cost analysis and decision analysis would be structured to address such sustainability issues.

Benefit-Cost Analysis

It would be unlikely that a benefit-cost analysis would be undertaken for the overall question of the attractiveness of new pulp and paper facilities in the region, recognizing the potential wilderness, electrical energy, and effluent control questions in one overall planning decision. A more likely approach would be that a separate benefit-cost analysis might be conducted for a question such as the best way to supply electrical energy to the facilities, given that they were going forward. Suppose that benefit-cost analysis were being conducted for the best way to control liquid effluent from the facilities that would likely enter the Fraser River. While CTMP mills need not utilize the chlorine bleaching that is common in the kraft process, there still would be water emissions from the facilities that would require specific emission control strategies.

For such a decision, the typical approach for a benefit-cost analysis might be to take issues such as the level of production of the facilities and their location as a given and then analyze one or possible two emission control approaches compared to a status quo situation of no control. The costs of such facilities could be calculated in terms of the aggregate increase in capital costs, which would include labour, land, and construction materials that would be required to construct and operate the emission control facilities. Benefits of the control alternatives would be less readily quantified. One would separate the benefits into avoidance of adverse effects on fish populations and avoidance of adverse on human health. Within the benefit-cost framework, the ideal approach to evaluating these benefit streams would be to undertake contingent valuation studies that ask people one of two kinds of questions. Either they would be asked their willingness to pay to reduce potential impacts on fish resources and human health or they would be asked how much they would have to be compensated to allow some deterioration, or more likely some increase in risk, to the human and fish population health. These questions would be asked of a random sample of people in the Fraser basin, cast in terms

of their personal incomes rather than questions associated with the cost of government regulation, as borne by the forest industry firms.

While this would be the most defensible approach to obtaining dollar values, more typically the time and resources would not be available to undertake large scale contingent valuation studies. In place, analysts might use information associated with the average value of sport fishing days, and hypothesize a relationship between increased risk to fish health and effects on sport fishing days to come up with some preliminary measure of the benefits of avoiding increases in risk to fisheries. Similarly, unit values taken from other studies for the value of avoiding potential human health effects (values per statistical life) would be employed to evaluate the benefits of avoiding human health impacts.

These benefit streams would be considered in conjunction with estimates of the cost of the facilities to come up with overall estimates of the costs and benefits from society as a whole, which would likely be defined as residents of British Columbia. The analysts would add up all the benefits and all the costs, irrespective of who pays the costs and gets the benefits. In particular, it would ignore the question of distribution of benefits from pulp and paper development and the distribution of costs in terms of users of the fish and water resources in the Fraser basin. If the aggregate benefits exceeded the costs, one of the emission control strategies would be selected as best.

Decision Analysis

A decision analysis approach would operate in ways that have some similarities to the benefit-cost strategies outlined above, but also some significant differences. First, a decision analysis approach would be more amenable to consideration of the higher order questions in Figure 1, such as what kind of overall industrial development and environmental quality do we want in the interior of the province. While addressing this question need not involve detailed analysis, it could consider the underlying values of stakeholders and decision makers to represent the features of a desirable strategy. Then, these overall perspectives could be used to influence the lower level decisions, such as investigation of the desirability of new pulp and paper facilities, recognizing their potential impacts on new electrical demands, as well as impacts on wilderness preservation and water and air emissions.

The basic approach would be to define one or more specific decisions that must be made regarding these developments, which may involve coordination across levels of government or ministries. Once specific decisions have been clarified, the next step would be to develop an overall set of objectives, broadly relevant for retail development and environmental decisions in the Fraser basin. Keeney and McDaniels (1992) provide an example of strategic level objectives for planning in BC Hydro, which illustrates the general approach. Once these overall objectives are structures, they could be refined for specific decisions, such as choice of waste management technologies or strategies for energy generation to meet the needs of pulp mills. After the objectives have been established, attention should be paid to the question of developing attractive alternatives that are more widely supported than would be the standard alternatives for a policy question. For example, McDaniels (1993), one of the background studies for this report, outlines how information about the objectives of various groups can be used to create more widely attractive alternatives. The example in the report is an attempt to develop more widely supported alternatives that could involve new pulp and paper developments in the BC interior receiving incentives to either self-generate electricity or adopt new energy conservation technologies that could reduce their demands for central generation.

Finally, after objectives and alternatives have been clarified, it would be possible to use various approaches that are similar to public involvement techniques to obtain information about priorities from groups. The formats for obtaining these value judgements could range from one-on-one interviews with selected decision makers, to small group elicitations in focus groups with stakeholders, to surveys involving detailed interviews with large numbers of people. Multiattribute approaches are more flexible in format and the type of question asked. In general, the focus is on asking questions that clarify how much of a change in one objective (say, cost) is judged to be worthwhile in order to achieve a specific change in another objective (say, environmental quality). Questions of this nature do not emphasize individual willingness to pay, but are cast in terms of the appropriateness of an expenditure by an organization like a government or a corporation. In some sense, the questions are closer to the regulatory and planning issues faced by governments.

6.0 An Institutional Context for FCA

Previous sections have stressed that FCA could be applied at different levels and different decision contexts in Fraser basin planning. Decisions about use of natural resources and about industrial and urban waste management are two particularly important contexts. The last section stressed that decision analysis is a flexible framework with which to address FCA. How then should this analytical framework be used to tackle these important questions? What are the best ways to foster use of FCA practices, within existing institutions, to achieve practical implementation?

To answer these questions, it is useful to consider the obstacles posed to FCA by existing institutional practice for resource management in British Columbia. One difficulty is the lack of coordinated decision making across line departments that have responsibilities in different regulatory contexts. For example, McDaniels (1993) discusses the need for integrated decision making about electrical energy and forest industrial development in the British Columbia interior. Decisions about forest industrial development are undertaken largely in the British Columbia forest and economic development ministries with no real mechanism for linkage to the electrical demands that will arise because of these decisions. This linkage is important because building new pulp mills in the interior will require construction of major new electrical facilities.

The second obstacle to using this type of analysis is the widespread reliance on standards-based approaches to environmental decision making, rather than comparison of the benefits and costs of alternatives. Standards-based approaches are attractive to regulators because they reduce the demand for complex analysis. Yet strict reliance on standards-based approaches eliminates the opportunity to make insightful decisions that consider the benefits and costs of greater control (Portney, 1990). For example, when British Columbia established its new pulp mill effluent guidelines for chlorine compounds in pulp mill wastewater, little analysis was conducted to determine the benefits and costs of this level of regulation compared to other levels. Setting standards in this manner and then relying on such standards as a blanket prescription for environmental regulation largely eliminates the potential for use of FCA in many contexts.

A third obstacle to FCA in existing institutional structures is the lack of trained personnel available to conduct such analysis. Government ministries do not have large enough staffs to undertake analysis of these problems on their own.

Recognizing these three obstacles, an institutional approach to FCA should ideally foster an integrated perspective that will lead to better decision making across agencies, involve use of policy analysis to supplement and help inform standard setting for environmental regulation, and lead to using existing staff resources better, so that more effective policy analysis initiatives can be undertaken across agencies.

The approach recommended here might be described as a "task force for sustainability policy analysis." The membership of the task force could include representatives of government agencies concerned with resource policy decisions in some regulatory or other capacity, as well as staff from academic groups and perhaps stakeholder group representatives. Members would share an interest in policy analysis of sustainability questions. The concern of the task force would be to foster and learn from FCA efforts that provide insight about sustainability policy questions.

The task force could be formally recognized and constituted as an inter-agency, inter-governmental group to encourage FCA and more informed approaches to decision making in the Fraser basin. If there are institutional or political obstacles to formal recognition of such a group, it might be able to proceed effectively informally. In either case, the intent would be to provide a forum in which strategies for FCA and evaluation of non-market goods could be discussed, and in which case studies employing FCA principles could be structured and analyzed. The collective resources of the group (which could include the staff resources and financial resources of the member agencies) could accelerate the pace and effectiveness of FCA and provide examples of good practice that can influence efforts elsewhere.

The proposed task force could be a useful institutional structure to help overcome the natural obstacles to FCA. For example, because the task force would have representation from a wide range of government agencies at the municipal, provincial, and federal levels as well as stakeholders and academics, it would provide a mechanism to overcome the compartmentalized view of resource decisions and bring a wider perspective to FCA practice. Second, it would work to encourage wise public decisions in key issues that would affect the future of the Fraser basin. The approach would be to structure important public policy issues along the lines discussed in Sections 2, 3, and 4 in this report, and use the combined resources of the agencies to conduct strategic, cost-effective analysis of the policy issues at hand. One of the key areas in which FCA could be conducted would be in more informed approaches to standard setting for environmental and land

use regulation. Finally, the task force would provide a forum in which to experiment with different approaches to FCA and learn from the experience of other agencies.

7.0 Steps to Implementation

As with any new venture, the proposed task force would benefit from initial steps that could provide opportunities for earning, as well as experience and some early successes. One strategy for the task force may be to work in conjunction with the relevant agencies on a specific decision. The intent would be to use the basic steps of FCA to quickly shed light on a complex problem through some preliminary analysis. More detailed analysis could then be conducted if merited.

One example might be FCA regarding effluent controls for pulp mills on the Fraser River. This is a politically charged issue because of the recent provincial government policies calling for stringent controls of AOx emissions from pulp mills. However, there may be an opportunity to influence the implementation of this policy, or reshape it in ways that may be less costly or more environmentally beneficial. A second example would be an analysis of wastewater treatment alternatives for the GVRD. Again, this is a politically charged problem, but also one in which there may be an opportunity for analysis to clarify these decisions.

Whichever case studies are selected by the task force, several steps will be helpful in achieving some impact on decision making at relatively low cost:

(1) *Emphasize developing a good structure for the decision.* This step has three key elements. First is a clear definition of the appropriate policy question, that is, the decision to be made. Second is a comprehensive, workable set of objectives for the decision. Third is development of a set of technically feasible and broadly attractive alternatives to be considered in the decision.

(2) *Use available information regarding the impacts of the alternatives to develop a quick objectives by alternatives matrix.* If information is unavailable, use judgements from experts, obtained in a well structured elicitation process, to get first cut estimates of the impacts of the alternatives.

(3) *Work with a group of informed stakeholders to provide information about reasonable value tradeoffs among objectives, that can be used to evaluate the alternatives.* One broadly based group that could be asked to provide informed views on tradeoffs is the Fraser Basin Management Board. A group such as this could provide judgements that help define the objectives and tradeoffs among the objectives, that would serve as a basis for a first cut analysis of alternatives.

The emphasis in these initial steps is on quick analysis that could provide insight with minimum time and effort. The intent is to begin to clarify a good structure for the decision and compile available information to conduct a preliminary assessment. It may be that after completing these steps no strategies emerge as clearly preferable, and so further investigation and refinement are required. On the other hand, it is possible that preliminary analysis could indicate one or two alternatives that have not been widely considered to date, and which deserve more detailed investigation. The contribution of the preliminary steps would be to demonstrate that a clear decision structure is crucial for making informed policy decisions, to show that one can use judgements provided by stakeholder groups as a means of gaining insight into the complex value tradeoff, and to use results from the initial work to set priorities for further data collection and clarify the information needed for a better assessment.

After the preliminary steps are completed, the task force and management agencies would have to consider how much additional research on technical and value aspects is needed to make a sound decision for the issue. This point raises the issue of "requisite" decision making, i.e., researching the question until sufficient information is at hand in order to make a responsible decision. To clarify the technical side of the decision, additional work could be conducted on probabilistic modelling of the impacts of the alternatives, or on whether new alternatives could be created. To investigate the values side of the decision, larger scale value elicitation activities involving more people could be conducted.

These last points raise the issue of the "representativeness" of value judgements obtained through elicitation methods. Contingent valuation attempts to achieve representativeness through random surveys of large numbers of people, which necessarily involve relatively little interaction with, or detailed questioning of, each person. Multiple objective value assessments attempt to obtain more detailed, carefully structured information from fewer people. Rather than depending on random surveys, multiple objective elicitation represents the views of groups important to the decision makers in order to understand

different perspectives. This strategy could work quite effectively if implemented through involvement with a multi-stakeholder panel that serves as "value advisors" for the analysis. If, after this step has been completed, the decision makers or analysts believe broader based value input is needed, then random surveys with multiple objective tradeoff questions or value elicitation workshops can be conducted. Referenda-like surveys that require participants to select from a set of alternatives, based on clear information about their benefits and costs, could be employed as an additional approach.

Once the task force has completed one analysis with both preliminary and detailed analyses, it could move on to other fundamental questions associated with sustainability policy issues in the Fraser basin. For example, issues such as how much population increase should be accommodated in the Lower Mainland, how urban land use patterns should be structured, how much wilderness preservation is best throughout the basin, how water resources should be allocated, could all be tackled on an iterative and incremental basis. Again, the emphasis should be placed on developing a good structure for the decision and on using information from stakeholder groups as a first cut source of information for the complex value tradeoffs. After that more detailed technical and value information could be obtained if needed.

The real payoff to work on FCA will come from improved decision practice, particularly improved approaches to representing complex value tradeoffs in sustainability policy questions. The task force approach suggested here, with reliance on the elements of good decision practice and decision analytic procedures for structuring a multiple objective framework, appears to hold the best hope of moving decision making forward in the Fraser basin. The ultimate objective of these activities is more informed and defensible decisions by government agencies in sustainability issues.

References

Boothroyd, P. (1991) "Developing Community Planning Skills: Applications of a Seven-Step Model," CHS Research Bulletin, Centre for Human Settlements, University of British Columbia, Vancouver.

Brookshire, D., Ives, B. and Schulze, W. (1976) "The Valuation of Aesthetic Preferences," *Journal of Environmental Economics and Management*, 3:325-346.

Brown, T. (1984) "The Concept of Value in Resource Allocation," *Land Economics*, 60: 231-246.

Clark, W.C. (1989) "Managing Planet Earth," *Scientific American*, 261, 3: 46-57.

Crown Corporations Secretariat (1993) *Multiple Account Evaluation Guidelines*. Province of British Columbia, Vancouver, February.

Edwards, W. and von Winterfeldt, D. (1987) "Public Values in Risk Debates," *Risk Analysis*, 7, 2.

Fischhoff, B. and Cox, L.A. (1986) "Conceptual Framework for Regulatory Benefits Assessment" in Bentkover, J. et al (eds) *Benefit Assessment: The State of the Art*. Dordrecht: Reidel.

Fischhoff, B., Slovic, P. and Lichtenstein, S. (1980) "Knowing What You Want: Measuring Labile Values," in *Cognitive Processes in Choice and Decision Behavior*, T.S. Wallsten (ed). Hillsdale, MJ: Erlbaum.

Fischhoff, B. and Furby, L. (1988) "Measuring Values: A Conceptual Framework for Interpreting Transactions with Special Reference to Contingent Evaluation of Visibility," *Journal of Risk and Uncertainty*, 1:147-184.

Fraser Basin Management Board (1993) *Strategic Plan for the Fraser Basin Management Program*. Vancouver, FBMB.

Gregory, R., MacGregor, D. and Lichtenstein, S. (1992) "Assessing the Quality of Expressed Preference Measures of Value," *Journal of Economic Behavior and Organization*, 17, 2: 277-292.

Gregory, R., Keeney, R. and von Winterfeldt, D. (1992) "Adapting the Environmental Impact Statement to Inform Decision makers," *Journal of Policy Analysis and Management*, 11, 1: 58-75.

Gregory, R., Mendelsohn, R. and Moore, Y. (1989) "Measuring the Benefits of Endangered Species Preservation: From Research to Policy," *Journal of Environmental Management*, 29, 4:399-407.

Jackson, T. (Ed) (1993) *Clean Production Strategies*. Stockholm Environment Institute, London: Lewis.

Keely, M.J., Montgomery, M. and Dovidio, J. (1990) "Reliability and Predictive Validity of Contingent Values: Does the Nature of the Good Matter?" *Journal of Environmental Economics and Management*, 19, 3: 244-263.

Keeney, R. (1992) *Value-Focused Thinking*. Cambridge: Harvard University Press.

Keeney, R. (1980) *Siting Energy Facilities*. New York: Academic Press.

Keeney, R. (1988) "Structuring Objectives for Problems of Public Interest," *Operations Research*, 36, 3, 394-404.

Keeney, R. (1982) "Decision Analysis: An Overview," *Operations Research*, 30, 5: 803-838.

Kelman, S. (1981) "Cost-Benefit Analysis: An Ethical Critique," *Regulation*, 5, 1:33-40.

Kirkwood, C. (1979) "Pareto Optimality and Equity in Social Decision Analysis," *IEEE Transactions: Systems, Man and Cybernetics*, SMC-9-89-91.

Knetsch, J.L. and Sinden, J.L. (1984) "Willingness to Pay and Compensation Demanded: Experimental Evidence of an Unexpected Disparity in Measures of Value," *Quarterly Journal of Economics*, 99, 3: 507-521.

McDaniels, T.L., Kamlet, D. and Fischer, G. (1992) "Risk Perception and the Value of Safety," *Risk Analysis*, 12, 4: 495-503.

McDaniels, T.L. (1993) "Sustainability, Value Tradeoffs and Electric Utility Planning," Centre for Human Settlements, University of British Columbia, Vancouver BC.

Mishan, E.J. (1981) *An Introduction to Normative Economics*, 2nd Ed. Oxford, UK: Oxford University Press.

Mitchell, R.C. and Carson, R. (1989) *Using Surveys to Value Public Goods: The Contingent Valuation Method.* Washington, CD: Resources for the Future.

Morgan, M.G. and Henrion, M. (1990) *Uncertainty: A Guide to Treatment of Uncertainty for Quantitative Risk and Policy Analysis.* Cambridge: Cambridge University Press.

Pearce, D. (1988) "Economics, Equity and Sustainable Development," *Futures*, December, 598-605.

Pearce, D., Markandya, A. and Barbier, E. (1989) *Blueprint for a Green Economy.* London: Earthscan.

Portney, P.R. (ed) (1990) *Public Policies for Environmental Protection.* Washington, DC: Resources for the Future.

Rees, W. (1990) "The Ecological Meaning of Environment-Economy Integration," *The Ecologist*, 20,1: 18-23.

Reiling, S. et al (1990) "Temporal Reliability of Contingent Values," *Land Economics*, 66, 2: 128-134.

Roessler, C. (1993) "Social Costing for Preservation Decisions," MSc thesis, University of British Columbia, unpublished.

Roessler, C. and McDaniels, T. (1994) "A Critique of Analytical Approaches for Full Cost Accounting," Environment Canada, Vancouver, BC.

Robinson, J.B. (1982) "Energy Backcasting: A Proposed Method of Policy Analysis," *Energy Policy*, 10, 4: 377-345.

Ruckelshaus, W.D. (1989) "Toward a Sustainable World," *Scientific American*, 261, 3: 166-174.

Ruckelshaus, W.D. (1985) "Risk, Science and Democracy," *Issues in Science and Technology*, Spring.

Sebenius, J.K. (1992) "Negotiation Analysis: A Characterization and Review," *Management Science*, 38, 1: 18-38.

Smith, V.K. (1986) "A Conceptual Overview of the Foundations of Benefit-Cost Analysis," in Bentkover, J. et al (eds) *Benefit Assessment: The State of the Art*. Dodrecht: Reidel.

Stavins, R. and Whitehead, B.W. (1992) "Dealing with Pollution: Market-Based Incentives for Environmental Protection," *Environment*, 34, 17: 42.

Viscusi, W.K. (1983) *Risk by Choice: Regulating Health and Safety in the Workplace*. Cambridge: Harvard University Press.

von Winterfeldt, D. and Edwards, W. (1986) *Decision Analysis and Behavioral Research*. Cambridge: Cambridge University Press.

Walters, C. (1986) *Adaptive Management of Renewable Resources*, IIASA.