A Framework for the Environmental Assessment of Demand Side Management Programs by Manitoba Hydro

by

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of the Requirements for the Degree

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"A FRAMEWORK FOR THE ENVIRONMENTAL ASSESSMENT OF DEMAND SIDE MANAGEMENT PROGRAMS BY MANITOBA HYDRO"

A practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfilment of the requirements of the degree of Master of Natural Resources Management.

By

Mr. Jeffrey J. Turner

Abstract

The aim of this research was to evaluate the need for the environmental assessment (EA) of demand side management (DSM) programs at Manitoba Hydro, and to determine the scope and framework for the EA of DSM programs.

Data used for this study were collected through the literature, interviews and a mail survey. DSM programs, their potential environmental impacts, the mitigation of these impacts, the components of an EA, and the legislative requirements for EA are examined through the use of the literature and interviews. The application of EA to DSM programs by other electrical utilities was determined through a mail survey of 155 utilities. Further, a description of Manitoba Hydro's power resource and DSM planning process, including an evaluation of its EA provisions, is presented drawing on internal Manitoba Hydro documentation. The culmination of the above research lead to the development of a number of alternative approaches to an EA suitable for application and evaluation within the power resource and DSM planning process of Manitoba Hydro. The optimum EA approach was selected and developed into a framework for the EA of DSM programs.

The examination of Manitoba and other Canadian legislation failed to identify a legislative requirement for the EA of DSM programs in Manitoba. The mail survey identified a limited number of utilities that performed EAs of DSM programs. Four general types of environmental assessment were identified: EAs used as planning tools for comparing the environmental impacts of demand and

supply side resources; EAs used to determine environmental externalities of DSM programs; DSM Program or issue-oriented EAs; and issue-oriented EAs of demand and supply side resources. It is concluded that the potential environmental impacts of DSM programs are limited, but that it is prudent to perform EAs to minimize the negative impacts while maximizing any positive impacts. The examination of the EA provisions of Manitoba Hydro's power resource and DSM planning process indicated there was very limited use of EA in this area. It was concluded that the EA of Selective Issues, would be the most appropriate approach to meet the needs of DSM program planning. This approach was developed into a two-staged EA framework (Selective DSM EA) for practical application and applied to Manitoba Hydro's Energy Efficient Lighting Program, which further confirmed the framework's usefulness.

This report recommends that Manitoba Hydro introduce the Selective DSM EA for application to DSM programs. In addition, further study into the use of long-range planning EAs and the selective use of quantitative analysis are recommended for enhancing the power resource plan's environmental analysis. It is also recommended that program feedback effects be considered when performing DSM EAs. A final recommendation is that Manitoba Hydro assume a pro-active role in the mitigation of potential environmental impacts from DSM programs through a partnership with industry and government.

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I wish to thank my family for their support and love and my brother who carried on with our business. A special debt of gratitude is owed to Kristin Erickson who carefully proofread the drafts of the document and who quietly endured at times a somewhat grumpy researcher.

A final debt of gratitude is owed to those who responded to the survey and to requests for information; their assistance provided much of the data for this research.

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List of Acronyms

BPA	Bonneville Power Administration
CFCs	Chlorofluorocarbons
CFL	Compact Fluorescent Light
DSM	Demand Side Management
EA	Environmental Assessment
EIA	Environmental Impact Assessment
NEPA	National Environmental Policy Act
PCBs	Polychlorinated Biphenyls
TPWM	Ten-Year Programme on Waste Management

CHAPTER 1
INTRODUCTION

1.1 OVERVIEW

Manitoba Hydro has adopted the policy of reducing electricity demand growth through demand side management (DSM). Traditional DSM programs have included measures to promote use of energy efficient lighting and appliance products, increasing the insulation of homes and businesses, and replacing industrial motors and processes with more efficient technology. There are two reasons for the adoption of DSM as a method of meeting electrical demand: to delay the development of new electricity generation facilities by avoiding major financing requirements and the accumulation of debt, and to reduce the cost of electricity to customers through lower consumption.

While the environmental impacts of DSM are presumed to be much smaller than those of existing energy supply options, their actual significance has received little attention. Four key areas of impacts have been identified:

1. Indoor air quality changes in homes and offices, primarily due to increased accumulation of toxins or their release from retrofit activities (e.g., accidental release of mercury or Polychlorinated Biphenyls (PCB's) during installation of new lighting equipment, Allergens, Tobacco Smoke);
2. Alterations in outdoor air quality, usually due to changes in thermal power plant operations that occurs when load shifting

measures are used; 3. Deterioration of the ozone layer as a result of the release of chlorofluorocarbons (CFCs) through early replacement of CFC-containing equipment; and

4. Reduced ground-water quality through the use of "ground-source" heat pumps and disposal of mercury vapour lamps and PCB containing fluorescent ballasts in landfills.

If Manitoba Hydro and other utilities are to adopt demand side management as a means of meeting electrical demand then a greater understanding of the possible environmental impacts is necessary.

1.2 OBJECTIVES

1. Determine whether there is a need for environmental assessment (EA) of DSM programs.
2. Determine the scope of any assessment.
3. Develop a framework for the environmental assessment of DSM programs at the program development stage.
4. Test this framework by its application to Manitoba Hydro's Energy Efficient Lighting Program.
5. Develop general recommendations regarding the use of the environmental assessment framework for DSM programs.

1.3 RESEARCH PROCESS

1. Perform a thorough review of the literature regarding the potential environmental impacts of DSM.
2. Perform a thorough review of EA literature specifically regarding approaches and methods.

3. Evaluate the impact characteristics of DSM programs and their effect on performing an environmental assessment.
4. Determine present and anticipated legislative requirements for assessing the impacts of DSM programs.
5. Determine the present and anticipated EA practices towards DSM programs at other utilities.
6. Evaluate EA practices within the power resource and DSM planning process at Manitoba Hydro.
7. Develop a framework for the environmental assessment of Manitoba Hydro's DSM programs.
8. Test this framework by assessing the environmental impacts of Manitoba Hydro's Energy Efficient Lighting program.

1.4 RESEARCH METHODS

This study utilized both primary and secondary information sources. Primary information was obtained from scheduled and unscheduled interviews as well as through the use of a questionnaire survey. Secondary sources included published and unpublished information from libraries, industry and government.

The review of literature involved determining the present state of knowledge regarding environmental assessment in general (Munn 1975, Holling 1978, Clark *et al.* 1978, Rosenberg 1981, Bisset 1980, Beanlands and Duinker 1983, Munro, Bryant, Matte-Baker 1986), and more specifically, policy and program assessment (Grove-White 1984, World Bank 1991, Bregha *et al.* 1990, Gibson and Savan 1986), as well as the impacts and mitigation of impacts of DSM programs

(McInnes and Unterwuzacher 1991, EPRI 1984, Pace 1991, Manitoba Hydro 1991).

Publications were obtained and consulted at local libraries including the University of Manitoba Libraries, University of Winnipeg Library, Manitoba Hydro Library, Manitoba Environment Library, Manitoba Hazardous Waste Corporation Library, Legislative Library and the Winnipeg Public Library System. Publications not available locally were obtained through interlibrary loan and in some cases through personal acquaintances, government agencies, and consultant groups. Technical publications describing the specification and properties of lighting equipment were obtained from the manufacturers (e.g., General Electric).

Little published information is available relating to program level environmental assessment; these gaps in the literature were in some cases filled by the use of mail inquiries and structured telephone and in-person interviews (Appendix F). The legal requirements for DSM program assessment were determined through consulting literature as well as federal and provincial government agencies including some inquiries into jurisdictions outside of Canada (e.g., the Netherlands).

Inquiries and interviews were also used to determine the impacts and management of impacts regarding mercury-containing lamps. Industry representatives (e.g., General Electric) and industry organizations (e.g., U.S. National Electric Manufacturers Association) were consulted regarding the environmental impacts of energy efficient lighting equipment. The regulations regarding the management of mercury-containing lamp waste were in some cases determined by inquiries with the environment departments at the federal and provincial levels and other government and private agencies (e.g., Manitoba Hazardous Waste Management Corp). Inquiries were also made outside of Canada regarding the regulations and management practices of mercury-containing lamp waste (e.g., Netherlands Environment Department, Swedish Environment Department, and Minnesota Office of Waste Management).

A questionnaire survey (Appendix C) was used to determine the present and anticipated procedures for assessment of the impacts of DSM programs and the management of the impacts of DSM programs at power utilities. The survey was provided to personnel at most Canadian and many of the larger United States utilities (e.g., Pacific Gas and Electric, Bonneville Power Administration) as well as European, New Zealand and Australian utilities (Appendix F). A total of 150 survey questionnaires were sent initially along with a return envelope and a cover letter explaining the purpose and objectives of the study. The letter also indicated that survey respondents would receive a summary of the study when it was completed (Appendix E). After the response rate declined a follow-up letter was sent to survey non-respondents (Appendix E). This letter noted the lack of a response from that particular utility and indicated that some interesting information had been obtained from other utilities, but that the study would be more complete with their input. Several more questionnaires were returned along with a few requests from utilities for another questionnaire because the first one was lost. In addition five more questionnaires were sent to utilities that had been suggested by other utilities, this brought the total number of utilities being surveyed to 155. The questionnaire used a mixture of multiple choice and long-answer format questions. Two question paths were provided, one for those who have performed some form of EA on their DSM programs and one path for those who had not.

The questionnaire was supplemented by several scheduled structured interviews with personnel within Manitoba Hydro (Appendix F). This was done in order to gain a better understanding of the present environmental assessment and power resource planning process at Manitoba Hydro and Ontario Hydro. At Manitoba Hydro some of the personnel included Tracy Moroz, a lighting program coordinator in Energy Management Program Development, Bill Hamlin, a resource evaluation engineer in the Power Resource Planning Dept., Tom Akerstream, the manager of the Energy Management Program Development, and Denis DePape, a senior policy analyst with Environmental Policy and Planning.

Development of the assessment framework occurred iteratively in conjunction with the literature review, questionnaire, and interview process. A trial of the assessment framework involved a limited assessment of the environmental impacts of Manitoba Hydro's Energy Efficient Lighting Program. The trial used data regarding the environmental impacts of mercury-containing lamps, assumptions regarding the programs success, as well as relevant baseline information that was available.

The results from the trial assessment and the information obtained from the utility questionnaire survey, literature review and interviews were used to develop recommendations regarding the further assessment of DSM programs using the assessment framework and the assessment process within the power resource and DSM planning process.

1.5 LIMITATIONS

This research had several limitations that restricted the results that were obtained. These were due to the limitations of resources in terms of information, time and funding.

Although a considerable number of environmental impacts can be considered by an assessment, this study was restricted to quantitative analysis of only primary impacts. In addition qualitative analysis of secondary and higher order impacts, including cumulative impacts, were done where possible.

1.6 DEFINITION OF TERMS

Environmental Assessment

Beanlands and Duinker (1983:18) provide a working definition for environmental impact assessment.

> ...a process or set of activities designed to contribute pertinent environmental information to project or programme decision-making. In doing so it attempts to predict or measure the environmental effects of specific human activities or do both, and to investigate and propose means of ameliorating those effects.

The term environmental impact assessment is used interchangeably with environmental assessment by many. This practicum will use environmental assessment or EA from now on.

Demand side management

An Institute of Electrical and Electronic Engineers (IEEE) paper defines demand side management as encompassing "the entire range of activities, whoever they may be initiated by, that influence the pattern and magnitude of a utility's load" (Gellings and Talukdar 1987:1-7). These activities include strategic conservation, peak clipping (or shaving), valley filling, load shifting, strategic load growth, and flexible load shaping. These terms will be defined at the beginning of chapter two.

Environmental changes and impacts

Broadly defined an environmental impact is the result of an action or activity in a particular part of the environment over a certain period of time that leaves the environment in a different state than it would have been without the action or activity. Examining the impact process in greater detail one can see that following an action or activity a change is produced in the environment. These initial changes in the environment can be called environmental changes; they represent the most fundamental change or impact produced. Later environmental changes that are linked to the initial environmental change are known as impacts since they follow the initial environmental change.

Environmental impacts can be classified into several levels due to the interconnection of events in nature. This leads to direct impacts and indirect impacts. These indirect impacts can be further followed by successive levels of impact, sometimes called orders of impact (i.e., First order, second order, third order and so on). In reality a single action likely produces many initial environmental changes, each with a number of direct impacts, and each direct impact followed by a sequence of indirect impacts. If one considers the environmental changes and impacts in a subjective way they can be either beneficial or adverse, usually being referred to as positive or negative.

A good example is the harvest of timber from a hill, where the timber cutting and removal is the initial action. This action's first change to the environment is to reduce the population of trees on the slope of the hill. This environmental change produces increased soil erosion - a direct impact. There are numerous indirect impacts that are related and follow the soil erosion. These could include increased sediment in runoff, reduced soil fertility, increased aerial dust, alteration of fish habitat, as well as other indirect impacts not mentioned.

Cumulative impacts

Environmental impacts under certain circumstances can also be considered cumulative impacts. These are defined as environmental impacts that:

1) occur so frequently in time or so densely in space that they cannot be "assimilated," or

2) combine with effects of other activities in a synergistic manner (Sonntag *et al.* 1987:5)

Cumulative impacts can be characterized according to their interaction with the environment from a spatial, temporal and structural perspective.

Four types of cumulative impacts have been identified (Sonntag *et al.* 1987:6-7):

1. Linear additive impacts which involve the incremental addition of impacts to a fixed "large storage", with each increment having the same impact as the last;
2. Amplifying or exponential impacts involve incremental additions to a "limitless storage", with each increment having a larger effect than the last;
3. Discontinuous impacts occur when incremental additions produce no obvious impact until a threshold level is reached;
4. Structural surprise impacts are caused by several developments within a region affecting numerous ecosystems.

1.7 ORGANIZATION OF PRACTICUM

The practicum has an executive summary followed by chapter one; the methods section that discusses background, objectives, methods, constraints, and definitions. The second chapter discusses DSM, environmental impacts and their assessment. Chapter three discusses the development of an EA framework for DSM programs as well as the legislative requirements for DSM EA. The present state of DSM program environmental analysis at other electrical utilities is presented in chapter four. The focus of chapter five is the power resource and DSM planning process at Manitoba Hydro. Chapter six develops and evaluates various EA approaches. Chapter seven develops and tests the DSM EA framework. Conclusions and recommendations are given in chapter eight.

The appendices contain a large of amount of material that contributed to the study. These include a discussion of policy, project, and program environmental assessment in Appendix A, and a review of EA legislation both in Canada and elsewhere in Appendix B. The analysis of the utility survey and the results of the survey alongside a sample of the survey are given in Appendix C. A review and discussion of several examples of program EAs are found in Appendix D. Samples of the letters used in communicating with survey recipients are given in Appendix E. A complete list of the survey recipients as well as the organizations and people contacted through mail, phone and fax are located in Appendix F. The trial EA of Manitoba Hydro's Energy Efficient Lighting Program is given in Appendix G.

CHAPTER 2

DEMAND SIDE MANAGEMENT PROGRAMS AND THEIR ENVIRONMENTAL IMPACTS

2.1 DEMAND SIDE MANAGEMENT PROGRAMS

DSM programs can be broken down by the technique used (providing information, regulations, incentives), by the energy using sector (residential, commercial, industrial) by the target audience (e.g., homeowners, contractors), or objective (e.g., behavioral change), or by geographic region (Robinson 1991:636). Gellings and Talukdar (1987) discuss the various types of actions that utilities have available for load shaping and demand side management and which are encouraged through utility programs. These actions or types of programs are defined under six headings: Peak Clipping, Valley Filling, Load Shifting, Strategic Conservation, Strategic Load Growth, and Flexible Load Shape.

Peak Clipping occurs when electricity use is reduced during peak periods thereby lowering the peak demand that utilities must meet. This measure can also be used to reduce operating costs and limit dependency on expensive fuels by limiting the peak demand. An example of peak clipping is utility control of electric hot water heaters that disables the load of these heaters during peak periods of electricity demand.

Valley filling is an action that allows the utility to increase the electrical load away from peak periods of demand. This can contribute to lowering the average costs of electricity. A primary means of valley filling is the movement of industrial production from peak times of the day to off-peak periods.

Load shifting is the movement of peak loads from peak periods without any shift in energy use patterns through the use of an energy storage device. This is commonly in the form of an ice tank for air-conditioning storage and a ceramic brick furnace for space heating storage.

Strategic conservation includes measures to conduct or encourage conservation through behavioral and non-behavioral means. Behavioral means include the use of advertising or education to encourage people to conserve energy (eg., thermostat setback, turning off lights). Alternatively, other methods are non-behavioral and promote energy efficiency improvements, often by providing rebates or other financial incentives for purchasing energy efficient equipment, appliances, or structures (eg., energy efficient lighting, insulation upgrading, or more efficient appliances and industrial processes).

Strategic load growth involves increasing the sale of electricity to specific customers to increase market share where competition exists with other energy sources. This would include conversion from gas to electricity for hot water heating or process heating as well as the installation of heat pumps.

Flexible load shaping is the final form of demand side management entailing the sale of power to customers with price incentives but at lower levels of reliability. Depending upon the time of day and electrical supply reliability the subscriber will have a flexible load-shape. This can take the form of load cooperatives, interruptible service, or use of power limiting devices for individual users.

These DSM program classifications may overlap. For example, although utility control of electric hot water heaters is a form of peak clipping it can also be considered a form of load shifting, given sufficient storage is present to leave the energy use pattern unaltered. Gellings and Talukdar (1987) note various techniques have been employed to achieve the goals of these programs. Many of these have been mentioned above including end-use equipment control, utility equipment control, energy storage, incentive rates, dispersed generation, energy co-ops, customer DSM promotions, performance improvement of equipment, and industrial processes.

McInnes and Unterwurzacher (1991) also outline the end-use efficiency measures that have been contemplated by utilities in North America and Europe concentrating on the obstacles presented to their successful implementation. They indicate the opportunities available for efficiency improvement as well as the obstacles present, time-frames for their achievement and the impact on electricity consumption of various end-uses. The end-uses discussed include residential and commercial space heating, residential water heating, residential refrigeration, lighting, and industrial motors. They conclude that lighting, refrigeration, and energy efficient motors represent the most economically promising areas for end-use efficiency improvements. However, they also bring forward the need for careful analysis of the impact of DSM programs over the short as well as the long-term. They give the example of a DSM initiative gone awry when compact fluorescent lights are used longer than the lights they replaced as a result of their lower operating cost.

At the beginning of this section it was noted that utility DSM programs use several techniques. These range from providing information, incentives, and in some cases regulation. Another method of performing DSM is to deliver DSM programs directly by providing financing and/or installation services for energy efficient equipment (Robinson 1991). This new approach to DSM would have the utility more directly involved in managing the use of energy efficient equipment, both before and after installation. If this approach is adopted by utilities the mitigation of DSM environmental impacts will most likely involve these same utilities.

2.2 DEMAND SIDE MANAGEMENT ENVIRONMENTAL IMPACTS

Demand side management programs create impacts in two distinct ways. The first is through the demand side program and its measures. These create environmental changes and impacts through the release of environmental contaminants (eg., Mercury released from discarded fluorescent lamps). The second is through the altered need to generate electricity through program induced demand changes. These are avoided supply-side impacts: without the program the electricity would need to be produced along with all related environmental impacts.

2.2.1 AVOIDED SUPPLY-SIDE IMPACTS

These impacts vary considerably depending upon the type of generation system that is supplying the electricity and the characteristics of the changing demand for electricity. As noted by Platis and McCammond (n.d.) it is the generation capacity at the margin that is important since it is here that electricity would have been supplied if the demand reduction had not occurred. Electricity demand at the margin has a temporal aspect. The daily marginal requirement is commonly known as the peak demand; several peaks can occur in the electrical demand that a utility must meet throughout the day (eg., breakfast, supper). The peak demand can also vary throughout the year with winter and summer peaks relating to changes in heating and cooling demand. Finally, the overall demand at the margin can change due to declining or increasing demand from one year to the next. In some utilities, generation required to meet the daily or seasonal margin would have been supplied by fossil fuel power plants that save fuel and reduce the related emissions (e.g., Sulphur Dioxide, Carbon Dioxide, Particulates) when generation from these sources is not needed (Platis and McCammond n.d.). If hydro-electric generation is providing this power, then only water use is reduced.

Meeting the demand for electricity as a result of changes to the overall demand at the margin is more complex. In the short term the peaking facilities may respond; however, the daily and seasonal peaks restrain the ability of these facilities to meet increasing demand. In these cases the only option is to either conserve, import, or add new power facilities. Therefore the long-term growth of electrical demand is another source of avoided supply-side impacts. However, these impacts relate to the timing of construction of new power facilities rather than the hours of operation of existing power facilities. If DSM programs reduce the demand for power the requirement for new generation can be delayed. This results in the avoidance of impacts for a period of time and is no less an impact than a reduction in fuel or water use by existing power facilities. When the major impacts of a generation facility are site-related, as in the case of land-use impacts of many hydro-electric facilities, a delay of only a year or two can be significant when one considers the magnitude of some impacts.

2.2.2 INDOOR AIR QUALITY

The agents affecting indoor air quality included the effects of weatherizing[1] homes and buildings, the effects of insulation materials, as well as PCBs, mercury, and radiation contained in lighting equipment. Weatherizing is felt to aggravate an existing problem with indoor air quality, rather than being the primary cause (Pace 1991). Toxic chemicals and allergens released from building materials, smoking, wood stoves, furnaces, smoking, pets, and soil below buildings all contribute to reducing air quality inside buildings. They note that mitigation measures such as the

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1 Weatherization and weatherizing describe the process of increasing the energy efficiency of buildings by reducing the infiltration of air into and out of buildings (eg., weatherstripping doors and windows, and caulking cracks in walls) and increasing the insulation of buildings.

installation of air-to-air heat exchangers can economically limit any negative impacts.

Concerns have been expressed about the release of mercury (Competitek March 1988 quoted in Pace 1991) and the release of radio-isotopes from compact fluorescent lights (CFL). Although energy efficient lighting is considered to have a "net environmental benefit" related to mercury released into the environment, questions remain about the health impacts in "micro-environmental settings" (Competitek March 1988 quoted in Pace 1991:491). The impacts of toxic chemical releases from lighting equipment is only considered significant when large numbers of lamps release their toxins at one time in an unventilated area (Competitek March 1988 quoted in Pace 1991). Through proper safety procedures, the risk from such an accident can be significantly limited (Competitek March 1988 quoted in Pace 1991).

2.2.3 OUTDOOR AIR QUALITY

Outdoor air quality is impacted by changes in emissions from thermal power plant operation due to load shifting. The main conclusion of Pace (1991) and others (Ontario Hydro n.d., EPRI 1984) is that load shifting represents the greatest impact from DSM activities on the environment. This is primarily because it does not decrease the requirements for producing electricity. When nuclear power plants are providing power, the environmental impacts are significantly different. These would include concerns for public safety and for the disposal of nuclear waste. The impacts of load shifting vary according to the mix of power plants that are used for peaking and non-peaking operation. For example, if an oil-fired power plant is providing energy during daily peak periods and a coal power plant produces the base load supply then a shift of energy requirements towards other periods will increase the operations of the base load power plant. In this example the operation of the more polluting coal power plant will increase while the less polluting oil power plant will decrease.[2] This situation is reversed in the present circumstances of Manitoba where the base load is derived from hydro-electric power plants with peaking provided by coal power plants.

The implication of chlorofluorocarbons (CFCs) in the depletion of the ozone layer has triggered government legislated reductions in their use. Refrigeration and air conditioning equipment and thermal insulation contain CFCs. Most CFCs are being replaced by hydrogenated CFCs (HCFCs), with other substitutes in development, all with a decreased ability to deplete the ozone layer (Pace 1991). DSM programs that encourage the purchase of efficient refrigeration and air conditioning equipment contribute to increased releases of ozone depleting substances when older equipment is discarded. The application of appliance efficiency standards has promoted the use of thicker insulation in refrigeration and freezer equipment as manufacturers create more efficient appliances (Pace 1991). Until

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2 It should be indicated that the cost of operating an oil or gas powered peaking facility is usually higher than a coal, hydro-electric, and some nuclear base load facilities. Load shifting can also defer the construction of new peaking facilities that will also result in lowering the cost of producing electricity (Pace 1991:500). Overall, both of these aspects of load shifting can lead to utility and public demand for load shifts in order to reduce the cost of electricity.

recently this insulation contained over three-quarters of the total CFCs contained in a refrigerator or freezer (Pace 1991). Although this suggests DSM programs will indirectly contribute to ozone depletion, the reduction and eventual elimination of CFC use will significantly limit any negative impact from future appliances (Pace 1991). In the meantime recycling programs have been developed to reduce the loss of CFCs from discarded appliances in a few places (eg. Germany, Great Britain, Wisconsin) (Pace 1991).

2.3 MITIGATION OF IMPACTS FROM DSM ACTIVITIES

2.3.1 INDOOR AIR QUALITY DEGRADATION

The mitigation of DSM program impacts on indoor air quality from weatherization has been discussed by Ottinger et al. (Pace 1991). The Bonneville Power Administration is one utility that has addressed indoor air quality problems by creating mitigation measures to be applied to new homes that are built to its "Model Conservation Standards" (Pace 1991:488). These measures emphasize the use of ventilation systems to decrease the concentration of toxins and allergens in interior air.

2.3.2 MERCURY RELEASE FROM LIGHTING EQUIPMENT

Two Swedish utilities have attempted to recycle compact fluorescent lights (CFL). The risk associated with discharges to the environment from discarded CFLs in Sweden when compared to other anthropogenic sources of mercury are described by Mills (1991). The combustion of coal to produce electricity leads to the release of mercury into the atmosphere. Therefore, when electricity is conserved, less mercury is released. The mercury contained in a CFL and released by the generation of the electricity required to operate the lamp amounts to 9 mg of mercury released per lamp (Mills 1991:277). This mercury release compares with 20 mg of mercury that is not placed into the environment when electricity is conserved by the use of a CFL as opposed to an incandescent lamp (Mills 1991:277). The magnitude of the release of mercury from mercury containing lamps must also be placed in the context of other sources of mercury to the environment. The largest anthropogenic source of mercury is presently from discarded mercury and alkaline batteries (Eutrotech 1991). Alkaline batteries with lower levels of mercury have been available for a couple of years in Europe and were recently introduced in Canada. Since alkaline batteries are by far the most common of these two types of batteries this will reduce the emission of mercury significantly.

2.3.3 PCB RELEASE FROM LIGHTING EQUIPMENT

Another source of environmental risk from lighting systems is the presence of PCBs in older, less efficient fluorescent lighting ballasts. The risk from these ballasts, however, is likely reduced by their proper disposal (Pace 1991). Re-lamping programs that update lighting systems by using higher efficiency ballasts (that do not contain PCBs) provide an opportunity for ensuring that the older ballasts receive proper disposal.

2.3.4 CFC RELEASE FROM BUILDING INSULATION AND APPLIANCES

Although CFCs will be curtailed significantly in future appliances, a large number of CFC-containing appliances are still in operation. These existing appliances will ultimately release their CFCs to the environment unless proper disposal takes place. In response, utilities have created a positive impact out of a negative one by the formation of CFC recycling programs linked to rebates for the purchase of energy efficient refrigerators (McInnes and Unterwurzacher 1991:215, Pace 1991:495-7). In Austria during 1989 consumers could participate in a rebate program for the purchase of new energy efficient dishwashers and refrigerators that allowed the organization of a program to treat used CFCs from discarded refrigerators (McInnes and Unterwurzacher 1991:215). Further recycling programs in Milwaukee and Wisconsin encourage early retirement of appliances (Pace 1991:495-7). Quantification of the amount of CFCs released by appliance recycling and retirement programs awaits future research.

2.4 ENVIRONMENTAL IMPACTS AND THE EA OF DSM PROGRAMS

Although there are a great diversity of DSM programs there are a large number of common traits. Almost all these programs involve strategic conservation and load shifting; they use new technology or techniques to reduce energy use or shift the time that energy is used

(Table 1). These programs are targeted at the residential, business, or institutional sector. As mentioned earlier, they can take the form of an incentive, information, or regulation, and often a combination of these.

2.4.1 TEMPORAL ASPECTS OF PROGRAMS

Most DSM programs involve the introduction of new equipment that is purchased by the user. For each piece of equipment there is an installation stage, followed by an operational stage, and finally a maintenance stage due to failures in equipment or replacement of products that have limited life-times. The post-program period follows the end of the program when equipment and products are no longer promoted. Impacts can occur at each of these stages; however, unlike project impacts which do not usually continue once a project has been decommissioned, program impacts can occur well after a program has ended.

There are two aspects to post-program impacts. First there is an installed base of equipment or technologies that may continue to function after a program has ended, and secondly, there are the changes in buying patterns that result in continued use of the equipment. Changes in buying patterns are one of the intentions of many DSM programs, that being the promotion of energy efficient technologies and equipment. These changes to consumer behavior will continue to have an impact in future years as users of this

Table 1 Potential Environmental Changes & Impacts of DSM Programs

Program	*Description*	*DSM Type*	*Potential Environmental Changes (Contaminants)*	*Potential Impacts*
Comprehensive Efficiency Improvement	**Residential** • Home Weatherization • Water Heater Efficiency Measures • Energy Saving Lights	SC[1]	• Solid Waste • Mercury • Radioisotopes • PCBs • Indoor Air Pollutants • Avoided[2]	• Health • Landfill Space • Ground Water • Avoided
Energy Efficient Appliances	**Residential** • Promotion of Energy Efficient Large Appliances (eg. Refrigerator, etc.)	SC	• Solid Waste • CFCs • Avoided	• Landfill Space • Global Warming • Ozone Depletion • Avoided
Water Heater Efficiency Retrofit	**Residential** • Water Heater Efficiency Measures • Energy Saving Lights	SC	• Solid Waste • Mercury • Radioisotopes • PCBs • Avoided	• Health • Landfill Space • Global Warming • Avoided
Water Heating	**Residential** • Promotion of High Efficiency Water Heaters	SC	• Solid Waste • Avoided	• Landfill Space • Global Warming • Ozone Depletion • Avoided
Industrial Retrofit	**Industrial** • Promotes: Cost-effective Lighting, HVAC, Motors, and Process Measures.	SC	• Solid Waste • CFCs • Mercury/PCBs • Radioisotopes • Indoor Air Pollutants • Avoided	• Health • Landfill Space • Global Warming • Ozone Depletion • Avoided
HVAC Remodeling and Equipment Replacement	**Industrial/Commercial** • Promotes Installation of Energy Efficient Heating, Ventilation, and Air Conditioning (HVAC)	SC	• Solid Waste • CFCs • Indoor Air Pollutants • Avoided	• Health • Landfill Space • Global Warming • Ozone Depletion • Avoided
Motor/Drive Replacement Program	**Commercial/Industrial** • Promotion of High Efficiency Motors and Other Measures.	SC	• Solid Waste • Avoided	• Landfill Space • Global Warming • Ozone Depletion • Avoided

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1 SC = Strategic Conservation

2 Supply side environmental changes and impacts vary with the generation source. These changes and impacts are usually positive since the DSM measure reduces generation impacts by reducing energy demand. Hydro-electric impacts include flooding and fishing impacts. Thermal generation impacts are related to the release of combustion by-products including carbon dioxide, particulates, sulphur dioxide, and nitric oxide.

Table 1 (Continued)

Program	*Description*	*DSM Type*	*Potential Environmental Changes (Contaminants)*	*Potential Impacts*
New Construction & Modernization	**Commercial/Industrial** • Promotes Energy Efficient Industrial & Commercial Building Design. (HVAC, Lighting, Industrial Equip., Water Heating, Appliances)	SC	• CFCs • Mercury • Radioisotopes • Indoor Air Pollutants • Avoided	• Health • Landfill Space • Global Warming • Ozone Depletion • Avoided
Commercial Retrofit	**Commercial** • Retrofit Measures for All End-uses.	SC	• Solid Waste • Mercury/PCBs • Radioisotopes • CFCs • Indoor Air Pollutants • Avoided	• Health • Landfill Space • Global Warming • Ozone Depletion • Avoided
Lighting Remodel and Equipment Replacement	**Commercial/Industrial** • Promotion of Energy Efficient Lighting during remodelling or replacement.	SC	• Mercury • PCBs • Radioisotopes • Avoided	• Health • Global Warming • Ozone Depletion • Avoided
Curtailable Rates for General Service Customers	**General Service Cust.** • Short-term Dispatched Load Reductions.	FLS[3]	• Avoided	• Avoided
Dual Fuel Program for General Service Customers	**General Service Cust.** • Promotion of Dual Fuel Space Heating and Cooling Systems and Water Heating. - (eg. electric heat pump with fossil fuel backup.)	FLS	• CFCs	• Ozone Depletion • Avoided
Backup Generator Rates for Medium and Large General Service Customers	**Medium and Large General Service Cust.** • Service Rate provides an incentive for customer to allow utility to curtail/interrupt supply for limited periods of time. • Customer uses a backup generator (usually diesel fueled) to replace supply.	FLS	• Avoided	• Avoided

3 FLS = Flexible Load Shaping

equipment replace aging equipment or obtain new equipment needed for expansion. Concerns over the fate of a new technology and equipment base, and changes in consumer behavior, are tempered by the fact that in many cases the energy efficient equipment was already being used. The efforts of utilities through the use of DSM programs amounts to the acceleration of a pre-existing process. Utilities responsible for the acceleration of a technological change need to acknowledge that mitigation measures related to the introduction of new technology may not develop on their own at a similar pace.

2.4.2 SPATIAL ASPECTS

The participants in most DSM programs are numerous and their geography is diverse. Many small actions occur at numerous sites. An example of a typical impact for a DSM program is the release of mercury from fluorescent lamps at a landfill site following disposal by a homeowner or business. This impact contrasts with the typical impact for a project which usually has a limited number of actions at a limited number of sites (e.g., hydro-electric power station). Impacts involving the promotion of DSM technologies and equipment can have local, regional, and in some cases global consequences. These consequences depend upon the causes of the impacts. The impacts of a project may be very large and focussed on a specific area or several bio-physical systems. However, the individual impacts of a program are often small, and they likely become significant only as cumulative impacts. Using the definition provided by Sonntag *et al.* (1987) a DSM program's impacts would usually only become significant having met either of two conditions; 1) program impacts accumulate in one place or at one time; 2) DSM program impacts combine synergistically with the impacts of other activities. An example of a DSM program impact meeting the first condition would be the contamination of a groundwater aquifer by antifreeze from a ground source heat pump. The second condition would be met if the antifreeze reacted with another contaminant to produce a more toxic substance than either initial contaminant.

Avoided supply-side impacts are another form of impact produced by DSM programs. These are positive (beneficial) impacts that occur through the deferral of energy use, its need to be generated, and many associated impacts. These impacts would have been produced by traditional energy supply facilities and as such the benefits from avoided supply-side impacts occur at and from these sites. Energy conserved in one area creates positive impacts at the generation site. In the case of coal powered generation facilities positive impacts occur at several locations. Less need for coal translates into reduced mining site impacts, less solid waste (coal ash) in landfills, lower levels of air pollution near the power plant and reduced acid precipitation and greenhouse gas emissions. This is not an all-inclusive list but it helps illustrate the complexity of considering avoided supply-side impacts.

Load shifting DSM programs may lead to avoided supply-side impacts; however, they also create new and different impacts as well. As mentioned in an earlier section, load shifting programs do not reduce overall electricity use, but they allow a utility to shift its need to generate electrical energy away from the periods of peak demand. The positive impacts from these programs relate to reduced need for peaking generation facilities. The type of peaking generation facilities that one has can have positive or negative impacts. If one has peaking facilities that use natural gas, then the impacts are different from those produced by hydro-electric facilities. As with the avoided impacts, these programs have impacts that originate with the facilities being used to generate electricity.

If avoided supply-side impacts and the impacts from load shifting programs are ignored, it is easier to discuss the way the geography of impacts can change with the life stage of equipment. Local impacts can result from the installation or maintenance of equipment, and in many cases, can be related to the release of construction waste or health impacts to workers conducting installation. Regional impacts can result from the spread of contaminants that produce impacts at a local level. In the case of a DSM program, these contaminants may be the leakage of toxic chemicals that spreads beyond the initial site of impact to the adjacent region. Those impacts that reach beyond the local or regional level can eventually become global impacts. Examples of these are the release of contaminants that are allowed to circulate for some distance into waterways or the air. The release of CFCs into the atmosphere is a good example of a local action that has a global impact on the environment.

2.4.3 PROGRAM FEEDBACK EFFECTS

DSM programs rely on the use of market mechanisms to promote reduced energy use. People are sensitive to the presence of real or perceived hazards. It can be argued that program participation can be negatively influenced by the identification of the impacts, any applicable regulations, and or cost of mitigation measures that may apply to these programs. In the United States resistance to some DSM activities for these and other reasons (e.g., liability for waste due to U.S. E.P.A. Superfund regulations) has recently been observed (Utility Environment Report 1992:13). Although there are no examples of a similar experience in Canada, it is likely that here to the regulations and mitigation for reducing emissions or exposure to negative impacts of a program may also discourage program participation. This would reduce the effectiveness of a program and any of the benefits it might otherwise have.

The success of a DSM program depends upon participation. If this participation is to be ensured, then the aspects of the program that could reduce participation or make it less attractive need to be considered in the development of programs. Program feedback effects should considered when DSM programs are developed.

2.4.4 ECONOMIC IMPACTS

The areas of the Manitoba economy affected by DSM programs are in the retail sale, installation, maintenance, and waste sectors related to these technologies and equipment, as well as the administration of the program itself. In some cases new employment could be created in these same areas of the economy. However, it must be remembered that some of the equipment that is promoted by these programs is not manufactured in Manitoba at this time and increased purchases will cause an outflow of money from the province (eg., lighting equipment manufacturers). This is not always the case however, some types of DSM equipment are produced in this province (eg., energy efficient windows) and would offset some of the out of province purchases. The economic activity generated both inside and outside the province needs to be considered in comparison to the expenditures that would otherwise be made for supply-side energy options.

2.4.5 SOCIAL IMPACTS

Few social impacts would occur as a result of DSM programs (Table 1). Lifestyle changes would be negligible for those participating in these programs. A comparison between the social impacts of a supply-side alternative and the DSM program should be made to bring the level of impacts into proper perspective. As mentioned earlier (Section 2.4.3), heightened awareness of the risks from the use of any energy efficient equipment could create hesitation for its application, whether justifiable or not.

2.4.6 SITUATION OF PROGRAM

The impacts from DSM programs are largely not site-specific, with the exception of some avoided supply-side impacts. However, in many cases the significance of impacts can be called situation-specific. That is, the seriousness of a program's impacts are largely dependent upon the situation in which the program is implemented (eg., regulatory, societal, or industry requirements and/or practices). The main reason for this is that the direct impacts of DSM programs are usually related to the emission of contaminant substances and their significance is determined by the situation of the release. Specific examples of situations that influence the nature of impacts include the level of training of lighting or refrigeration repair persons, or the presence of local recycling programs. In cases where both training and recycling programs are adequate the impacts will be few, and it is possible that they may even be positive since the program will act as a catalyst to promote the proper management of wastes. However, if these waste management programs had not existed it is possible that impacts could have occurred when these programs were implemented. Avoided supply-side impacts can be considered situation-specific and site-specific. These are situation-specific impacts because the type of impact that occurs depends upon the electricity supply system characteristics (e.g., occurrence of peak periods, types of supply resources). They are also site-specific because generation facilities produce different impacts depending upon their locations.

2.5 CONCLUSIONS

DSM program impacts can be divided into direct, indirect, and avoided supply-side impacts. The direct impacts are usually related to the emission of contaminants from DSM equipment leading to a small number of spatially diverse impacts of usually limited individual significance. The avoided supply-side impacts are an indirect form of impact, they vary by the utility since they are related to the facilities used to generate electricity. They are often large in number, usually spatially concentrated and can often become significant.

Many of the impacts from DSM programs can be characterized as situation-specific rather than site-specific in terms of impact significance. The direct impacts of DSM programs are usually related to the emission of contaminant substances and their significance is determined by the situation of the release.

DSM programs rely on the use of market mechanisms to promote reduced energy use. In a risk averse environment, the presence of real or perceived hazards, regulations or mitigation to limit any hazard can create “feedback” effects that can impede the success of a program and limit any positive impacts.

Although there is a mixture of positive and negative impacts resulting from DSM programs, from an overall electricity management context a net-positive impact usually results. Impacts that occur are typically small and outweighed by the reduction of impacts resulting from being able to avoid or defer development of new generation capacity. In addition, it is thought that many of the negative impacts can be mitigated if significant. In some cases the mitigation of impacts could help ensure that the positive impacts of DSM programs are actually realized. In other cases ensuring public health and safety may be the important objective of mitigation. There is a need to assess programs to identify those that have significant impacts and may require mitigation or monitoring.

CHAPTER 3

GENERAL FRAMEWORK FOR THE EA OF DSM PROGRAMS

3.0 INTRODUCTION

Developing a framework for environmental assessment requires an orderly discussion of what characteristics and components an environmental assessment (EA) should contain in order to serve as a starting point of development. In addition, this discussion will include an investigation into the present and anticipated legislative requirements for EA.

3.1 GENERAL FRAMEWORK FOR AN EA OF DSM PROGRAMS

The composition of individual EA approaches can vary considerably. However, EAs have several common components that include scoping, baseline prediction, prediction of impacts, significance of impacts, evaluation of impacts, monitoring, and mitigation. These components form a logical chain of inquiry that begins through scoping with the development of a good understanding of the core impacts that need to be investigated (Figure 1), developing a study plan that will guide the overall inquiry, and building a baseline from which to make predictions. These steps are followed by establishing a set of criteria by which the significance of impacts may be ascertained, evaluating the impacts of the different alternatives, and finally, suggesting mitigation to alleviate impacts and developing monitoring procedures

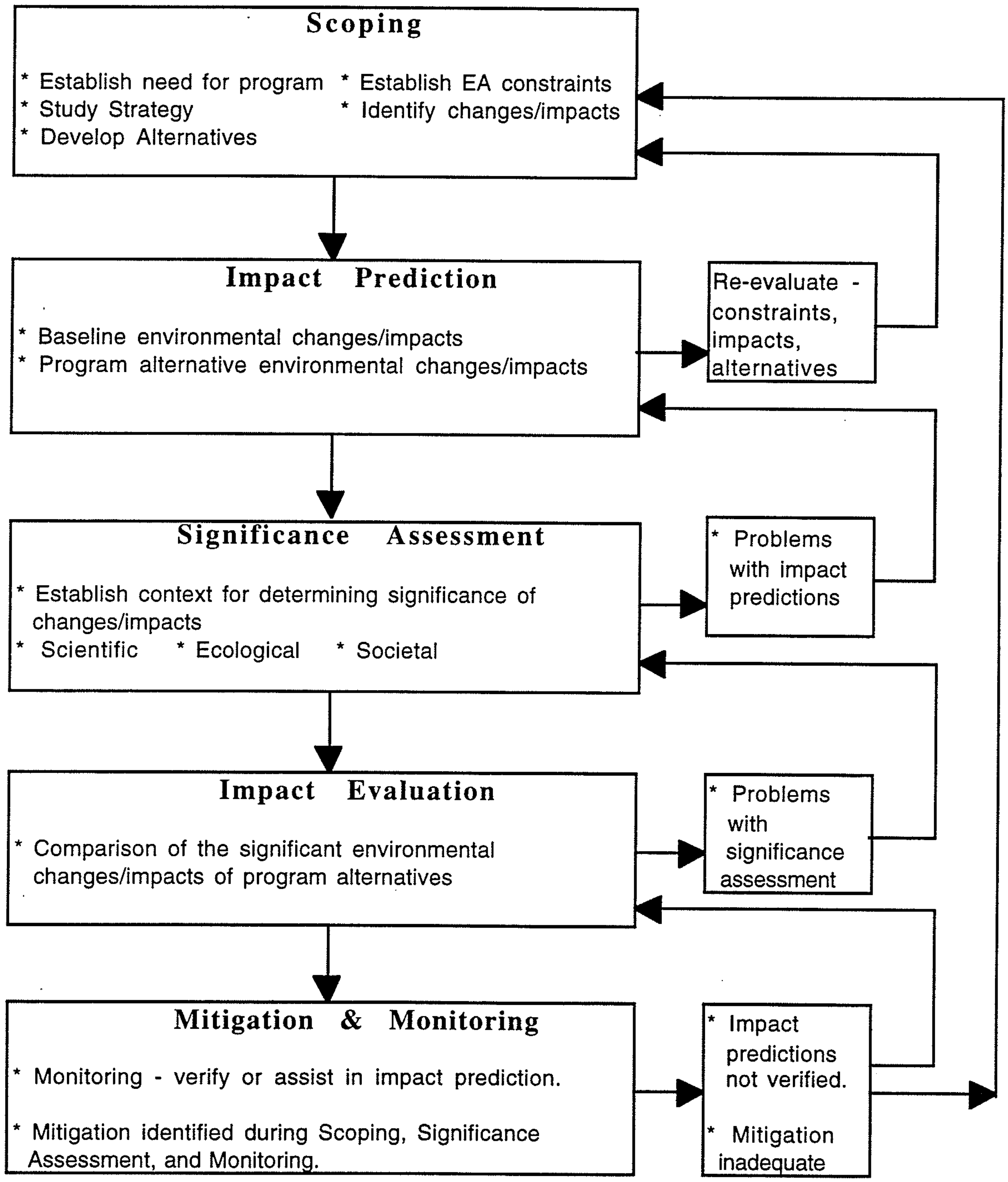

Figure 1: <u>Generic EA Process</u>

to verify both predictions and the success of any mitigation measures.

3.1.1 EA CHARACTERISTICS

3.1.1.1 Objectives of DSM EA

The EA would evaluate the environmental impacts of a DSM program or group of programs. Three variants are possible. First the EA could be used to choose amongst supply or demand side resources (e.g., Thermal generation or DSM). Second, the EA could consider alternative DSM programs. Finally, the EA could consider one DSM program and mitigation alternatives for that program.

3.1.1.2 Placement in Planning Process

In general an EA is more effective at influencing planning if it is done as early as possible. The timing of the EA would also depend upon its type, since an EA that was to consider demand and supply-side options would need to occur relatively early in the planning process as opposed to one considering mitigation alternatives for a DSM program. The amount and type of information available at the time would be the primary consideration for determining what type of EA could be performed.

3.1.1.3 Replicability

The replicability of an assessment is important in allowing it to be verified, thereby generating confidence in its results. This confidence can dictate the survival or at the very least the creation of public support for project or program. Two criteria can be used to judge replicability (Jain *et al.*, 1980):

1. Methodology should have a well defined structure and procedure.
2. Influence of the practitioner should be limited to allow for work to be replicated.

Replicability is of greatest importance when a document becomes a part of the public record and is open for criticism (e.g., Manitoba Clean Environment Commission Hearings).

3.1.1.4 Flexibility

There are three aspects to the flexibility of an EA: flexibility over a range of project scales, of project or impact types, and of project situations (Jain *et al.*, 1980). A project situation is similar to location although it has a broader definition that includes the local physical, biological, social, and administrative characteristics.

DSM impacts are predominantly related to the release of contaminants into the environment and impact types are unlikely to vary significantly between programs. Flexibility will be required for a DSM EA approach as it is applied to varying program situations, especially in regard to mitigation. Whether a program is applied to the residential or the business sector can lead to significant differences in the interpretation of impacts and their mitigation. Program scale is a less important influence on the EA since the impacts are the same regardless of program scale. The EA may require more resources but its overall structure is unlikely to change significantly.

A DSM EA method should be flexible enough for use with various DSM programs and program situations without major changes.

3.1.1.5 Resources Required

Resource requirements of an assessment can be divided into five areas (Jain *et al.*, 1980).

1. Cost of data.
2. Availability of skilled personnel.
3. Time required to learn and apply an assessment methodology.
4. Costs of applying method relative to other methods.
5. Technology and equipment requirements of methodology for monitoring and mitigation.

The limited number of impacts accountable to DSM programs would likely limit the resource requirements of any EA. It can be asserted from the results of the utility survey (Section 4.2) that the more resources required, the less likely it is that an EA will be performed. Deciding whether to perform an EA requires balancing the expected benefit, in terms of reduced planning uncertainty and increased public acceptance of the program, against the resource requirements of the EA. In cases where the potential impacts are serious enough to require significant resources to perform an EA, it is also possible that a program would be cancelled. The small scale of DSM programs (eg., 1-50 mw) and the presence of other DSM program options allows them to be replaced more easily than other power resources, possibly at a lower cost than some assessments.

3.1.1.6 Public Consultation

Although public participation in the scoping process will be discussed later, a few general comments can be made regarding public involvement in a DSM EA. The degree of public consultation that would accompany an EA of a DSM program is largely related to the type of program and whether mitigation was being considered. For example, programs that involve home weatherization and may possibly threaten the health of occupants often require specific standards or practices of weatherization in order to limit health hazards. This type of program would include an EA with extensive public consultation compared to EAs of programs with fewer or different impacts. Since the impacts of DSM programs are often not apparent at first sight or are perceived to be negligible, the utility should make an added effort to inform the public about the possible impacts related to these programs. In this way the public can participate in an informed manner in the EA consultation process.

3.1.2 ENVIRONMENTAL ASSESSMENT COMPONENTS

3.1.2.1 Scoping

The initial stage of an assessment is known as scoping. Issues are discussed, including the need for the program, alternative means of meeting the needs of the program, boundaries of the assessment and identification of the possible impacts on components of the environment (e.g., air quality) as a result of a program are discussed. It is here that the concerns of specific groups, individuals, and experts are first addressed by the assessment.

There are a number of ways of deciding who will be a part of the scoping process (Whitney and Maclaren 1985). Self-identification of individuals or groups of people allows the most vocal to express their concerns about the EA and the program's impacts. The EA study group can itself identify these relevant groups or an opinion survey can be used to indirectly include those affected in the process. This latter technique is noted as important because it allows for the less active groups and individuals to give their opinions as well.

The level of public input appropriate for a DSM EA would depend upon its placement in the planning process. At earlier stages no input or a public opinion survey may be sufficient while at later stages more involved participation may be necessary, especially in regard to the evaluation of mitigation measures.

Although it is useful to consider a large number of alternatives and environmental components in an EA, limited resources necessitate that limits be placed upon the number of alternatives and environmental components that can receive study. It is important that several alternatives be considered to allow for a thorough consideration of different ways of achieving the goals of the program. The inclusion of the "no program" alternative is required to highlight any avoided impacts of a program. Unfeasible alternatives are removed from the assessment at this stage so that limited resources can be focussed on those alternatives most likely to be implemented. The number and type of alternatives considered during a DSM EA will be influenced by the structure and maturity of the utility planning process.

The scoping process will include identification of the impacts and environmental components to be considered in the EA. Environmental components can be divided into two categories, those valued by the public or society and those that are scientifically relevant (Whitney and Maclaren 1985).[1]

The setting of boundaries limiting the environment to be evaluated in the study has important impacts on both the success of the EA and the human, monetary and time resources required to

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1 Environmental components are divided into two categories by Whitney and Maclaren (1985): those "phenomena" that the public consider to be of significance or of value are known as "publicly valued environmental components" or PVECs. A PVEC represents a "specific environmental component of the environment and the socially derived attributes of that component" (Whitney and Maclaren 1985: 6). An example of a PVEC would be water quality. The other type of environmental component is the scientifically relevant environmental component (SREC). These components are the biophysical and socioeconomic means of influencing the PVECs. An example of an SREC related to the previously mentioned example of a PVEC would be lead levels or pathogenic bacteria counts in drinking water. The SREC could take the form of relationships, variables and processes that influence the PVEC (Whitney and Maclaren 1985:7). This should include an explanation of the selection process that was used in choosing criteria as well as any influence on the program or project that could result from changes in these ECs (Beanlands and Duinker 1983:93).

complete an assessment. Boundaries that are too inclusive can be unnecessary and costly while those that are too exclusive can fail to include impacts of a regional nature reducing the effectiveness of the EA. There are several types of boundaries. A relatively definitive list describes five types of boundaries: administrative, project, environmental, temporal, and technical boundaries (Whitney and Maclaren 1985). These five boundaries are easier to discuss if we divide them into spatial, temporal, and technical boundaries.

The spatial boundaries include administrative, project, and environmental boundaries. Administrative boundaries include the boundaries of cities, municipalities, provinces/states or countries. Project boundaries reflect the physical presence of these human activities. An example would be the area flooded by a hydro-electric facility. Environmental boundaries reflect the area described by the environmental components (eg. water quality) to be considered in the study. An example of this would be trout spawning areas on certain streams.

Temporal boundaries can take two forms that differ over the length of the defined study time period. There is the length of time over which impact predictions are made, often the length of an activity, project or program. The other boundary is the shorter term "variability and periodicity" of any environmental changes or impacts (Whitney and Maclaren 1985:7). An example that illustrates this would be short term influxes of construction activity that may have a small impact on bird nesting areas because the periods of nesting do not coincide with construction. However, the long term impact of cars at the completed facility year-round (i.e., during nesting) may produce a large negative impact. The changes that are most important over time are the "response and recovery times of affected systems" (Beanlands and Duinker 1983:93).

Technical boundaries involve the restrictions placed on the study by the types of data used and the technical capabilities and personnel skills of the assessors.

A procedure for determining boundaries has been suggested by Beanlands and Duinker (1983). They note that an assessment should follow a bounding procedure that first considers boundaries related to administrative authority. Within these boundaries the temporal and spatial constraints of the project should be considered. Again, within the previous boundaries, ecological boundaries should be developed. Finally, technical boundaries upon the completion of the study should be considered. They indicate that bounding of the study need not be the same for every "ecosystem component" (Beanlands and Duinker 1983:93).

The boundaries of a DSM EA would vary according to the program being studied and the objective of the EA. Spatial boundaries will likely be the utility's service area and more specifically the part of the service area that is receiving the program. However, when avoided supply-side impacts are considered it may be necessary to extend the analysis beyond the service or program areas, because of the long-range of these impacts. Temporal boundaries would likely be the length of the program since that is the length of time of the activities creating the impacts. Unfortunately, while this time limit may be necessary for planning purposes, it fails to consider continuing impacts from changes to product purchasing behavior and installed equipment.

Another part of scoping can be the development of a study strategy. The strategy should include a plan to guide and coordinate research to determine interactions between the project and the ecosystem components (Beanlands and Duinker 1983). This strategy would be especially important when hypothesis testing is necessary for impact prediction.

A number of methods or techniques that are used to identify impacts are commonly used with larger project EAs (eg., matrices, checklists, and systems diagrams). These would not be used extensively by those performing DSM program EAs. The impacts related to DSM programs are not as numerous as with large projects and the identification of impacts does not require a dedicated technique. One exception is the numerous avoided supply-side impacts related to DSM programs; for these impacts an identification technique may be necessary to avoid leaving impacts out of the analysis.

3.1.2.2 Impact Prediction

The characterization of expected impacts upon various environmental components by the program is the central purpose of impact prediction. Impact prediction includes prediction of baseline conditions from where impact predictions can be made. Several approaches can be followed in predicting the impacts upon the environment. The first approach utilizes expert judgements or extrapolation from "verified predictions" for similar projects (Whitney and Maclaren 1985). This approach can be enhanced by the verification of predictions during monitoring (Whitney and Maclaren 1985). When an EA of a project is to be performed with limited resources, this is often the preferred approach.

The second approach is used where existing models of relationships are applicable and information is available for making impact predictions about the project (Whitney and Maclaren 1985). However, in order to validate the predictions, the assumptions of the models need to be tested, and a monitoring program is necessary to ensure the accuracy of predictions and to modify the models if necessary (Whitney and Maclaren 1985).

The final approach is to orient the assessment around the formation of an impact hypothesis (Whitney and Maclaren 1985). Following the formation of a research hypothesis a null hypothesis should be formed with the identification of statistical significance levels that will determine the acceptability of the null hypothesis. Finally, the research hypothesis can be "tentatively" accepted following consideration of the results of the monitoring program. No matter which approach is used the study of systems interactions will lead to a more thorough analysis of all impacts, both direct and indirect impacts (Whitney and Maclaren 1985).

All of the prediction approaches could find use in DSM EAs, however the limited resources would point towards the use of the first or second approaches involving extrapolation from other programs or using existing models or relationships. In some cases it may be necessary to apply the impact hypothesis approach to predict the impacts of a program.

The relatively early stage of development of most DSM programs may mean that there is limited information concerning certain impacts. In many cases, however, generic impact estimates are available for use in the EA for extrapolating from other programs. There are several drawbacks to using generic impact estimates (Pace 1991:68-69). The generic impact estimate is an average that does not take into account site characteristics; many environmental impacts are site specific and here the marginal impact is most accurate; therefore, this method often underestimates the true environmental impact. Power resources with mainly site-specific impacts such as hydro-electric facilities are obvious examples of a project where marginal impacts are most accurate. When a power generation facility produces impacts that are not site specific then generic impact estimates can be used. The use of generic impacts is also a reasonable method when considering resources at the policy level where average impacts rather than marginal impacts are a concern, even when site-specific resources are being assessed. It was also noted that when no other information is available, generic impact estimates may need to be used.

The use of generic impact estimates has occurred in several program EAs including three that consider DSM programs to varying degrees (Appendix D). A good example of this is the thermal pollution released by a coal fueled generation plant of a specific size and type. In this case many of the impacts do not depend upon the site (eg. aerial emissions) while some can change with the site (eg.

land use impacts). Therefore generic impact estimates can be helpful, but can only be used selectively.

It has been noted that an EA should begin by focusing on making predictions for changes in physical and chemical components and their direct impacts on ecological components. Later, the EA can consider indirect effects that often appear as changes in habitat or food (Beanlands and Duinker 1983). The use of environmental changes as a proxy for estimating direct impacts has been used in several EAs (Appendix D). Using environmental changes for impact prediction has both advantages and disadvantages. Although determining direct or indirect impacts from an environmental change can be limited in many cases by the variability of the environment and each situation, it is possible to compare the relative environmental changes from one program alternative with another and expect these relative environmental changes to reflect the relative environmental impacts. Using the thermal power plant example again, the thermal pollution of several alternative power plant designs could be compared, indicating the relative impacts upon a river or lake.

There are several arguments for using this method for estimating impacts. The first is the relatively limited resources required to perform this type of EA: this is especially the case since many of the generic impact estimates noted earlier are made for environmental changes rather than impacts. Another argument is illustrated by the EA of the ten year waste management plan for the Netherlands (Appendix D). This EA's consideration of environmental changes facilitates the analysis of the aggregate or national impacts resulting from alternate waste management programs. In this case the numerous waste management sites are not assessed individually, but rather collectively.

The same approach can be applied to any program where the impacts are spatially diverse. This is especially true when considering many of the impacts resulting from DSM programs. The wide spatial distribution and large number of impacts makes it difficult to determine the cumulative impact of all activities since the local conditions and/or the site characteristics vary. While it may be possible to study several program participants, their number and variability would require a significant effort of sampling and analysis. The mercury impacts from fluorescent lighting provide an example of the problem. While it might be possible to determine the fate and effects of wastes in one landfill, the impacts would vary according to the landfill site that received the wastes and impacts related to transport and handling would be different in every situation. This would be even more complex should incineration be the disposal method. There are exceptions amongst DSM programs, and some produce impacts which more easily lend themselves to prediction of direct impacts. One of these is the impacts of home weatherization programs, where a mathematical model can be developed for one or several types of homes and the related health impacts of reduced indoor air quality.

Several methods are available to make impact predictions with varying levels of “scientific rigour”:

1. Modelling: mathematical or mechanical simulations, statistical techniques (eg., variance and correlation);

2. Pre-project experiments;
3. Extrapolations from areas with “analagous” environmental components and “project designs” for which quantitative or qualitative results are available;
4. Forecasting: time-series, expert opinion consensually established, expert opinion of individuals (Whitney and Maclaren 1985:8-9).

A number of requirements and limitations need to be considered when doing an EA. Impact prediction analysis should include rationale for the prediction, limitations of any prediction, and the following additional components: “nature, magnitude, duration (timing), extent (geographic distribution), level of confidence, and range of uncertainty of the predicted changes” (Beanlands and Duinker 1983:94). The prediction of the baseline values for environmental components should include the consideration of without-project changes that may occur to these components over time. It should be determined early on what level of measurement[2] will be used in the EA since this will determine the eventual mathematical manipulations that will be possible with the data (Whitney and Maclaren 1985).

Variability of environmental components over time and space should be considered in the EA. There are two types of variability:

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2 There are four levels of measurement; each allowing different types of mathematical operations. Nominal: eg. 1,2 unranked (No mathematical operations); Ordinal: eg. 1,2 ranked (No mathematical operations); Interval: eg. 22 Degrees Celsius (Multiplication and Division if of same scale); eg. Ratio: 33 Meters (All Mathematical operations) (Whitney and Maclaren 1985).

changes of environmental component relationships and stochastic (random) effects (Whitney and Maclaren 1985).

Variability in the relationships between environmental components over time should be discussed when predictions are being made (Whitney and Maclaren 1985). The magnitude of an impact upon environmental components may be estimated incorrectly if the variability of a component is not determined before the determination of impact significance. As an example, an environmental component with a natural cyclical variation may be measured at a low point in its natural variation. At this point an impact upon this component may be large but not significant, because it is within the natural variation of that component; however, when the natural variation becomes less, the impact may exceed the bounds of natural variability and reach significance.

In addition, every prediction exhibits a certain degree of uncertainty that can be limited, but will never be totally eliminated. One way of identifying the stochastic or random element of a prediction is to provide a range of predictions, along with frequency distributions and probabilities (Whitney and Maclaren 1985). Overall, the problem of uncertainty can also be addressed by using sensitivity analysis.

Sensitivity analysis is a means of determining the level of uncertainty of impact predictions; the process follows the general outline below (Whitney and Maclaren 1985). Assumptions used in arriving at the predictions are varied until the magnitude of the predicted values begin to change. The level of uncertainty in the prediction is low if it requires a large change to produce alterations in the predicted value. The opposite is true if a small change results in a change in the predicted value. A more thorough analysis should be given to those predictions found to be sensitive. While the uncertainty of known phenomena can be evaluated another aspect of uncertainty in phenomena is difficult to evaluate. This applies to those unknown phenomena that we lack the knowledge to understand. For this type of uncertainty there is no answer but further research.

Risk assessment is a part of impact prediction that usually considers the probability of uncertain and negative impacts (Andrews 1988). It is common for the impacts to include public health and safety. An example would be an estimate of the probability of a dam failure. These assessments often give estimates of probability, the population that is affected and the other impacts likely to result (Andrews 1988). Risk assessment can be applied to DSM programs where new technologies and their related hazards are determined.

3.1.2.3 Significance Assessment

A significant impact can be defined as a predicted environmental impact in an environmental component within certain temporal and spatial boundaries that should be considered in decision making (Beanlands and Duinker 1983). The significance of impacts is determined by evaluating impact predictions by several means (Whitney and Maclaren 1985):

- Impact duration, relative magnitude, and risk.

- With and without program comparison (Baseline comparison).
- Environmental component sensitivity: stability[3] and resilience.
- Cumulative changes/impacts
  - similar activities in region with & without program.
  - similar environmental changes/impacts from other activities.
- Quality Standards and Criteria

Determining significance is further complicated by the different criteria (e.g., statistical, ecological, social) that can be used (Beanlands and Duinker 1983). Statistical significance considers the difficulty in determining environmental changes caused by a project against the existing variability of environmental components. Ecological significance evaluates the importance of environmental changes resulting from a project without being influenced by social values. Social significance considers the importance of environmental changes resulting from a project upon ecosystem components as determined by society. Each of these criteria may produce a different judgement regarding the significance of the same impact.

3.1.2.4 Evaluation of the Impacts of Alternatives

Although most aspects of an EA are to some degree a product of subjective judgements, the impact evaluation is the one in which the most obvious subjective judgements are made. The impact evaluation considers the importance of significant impacts of environmental components in relation to each other (Whitney and

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[3] Environmental components may be unaffected by a specific environmental effect until a threshold point is reached resulting in a serious impact.

Maclaren 1985). There are numerous means of conducting an evaluation. Central to an assessment is the consideration of alternatives, the process of comparing the impacts of project alternatives on environmental components. This can be through the tabular comparison of impacts and the aggregation of impacts from each alternative.

Aggregation of impacts involves the summation of significant impacts for each alternative. This summation aids in the comparison of the total significant impacts deriving from these alternatives. Aggregation has been a much debated procedure with many detractors as well as supporters. The argument for aggregation has focussed on its ability to simplify the number of factors needing consideration by a decision maker when evaluating alternatives. In an extreme example, the ranking of alternatives by their individual impact scores effectively removes the decision from the decision maker by making the most desirable alternative obvious. It has the advantage of alleviating the burden of understanding the large amounts of information in an assessment. The contrary argument given is that there is a loss of information about the impacts and the significance of impacts on individual environmental components. One of the other problems with aggregation that has already been alluded to, is the inability to sum impacts in a mathematically valid way unless the values are of the correct level of measurement for aggregation. The other problem lies with values that use different units which also cannot be properly aggregated.

The need for aggregation, with all of its difficulties, can be lessened or eliminated using several methods. Primarily these involve reducing the number of alternatives as well as the number of environmental components that require evaluation.[4]

The aggregation of impacts can also include the application of weighting values to environmental components. Determining which person or group provides these values is one issue. Two other issues involve determining the relative weights of different environmental components, and using the environmental component weightings produced by different groups to aggregate impacts and produce one measure of an alternative's impact (Whitney and Maclaren 1985). If the weights of different groups are to be considered then different evaluations should be conducted of each alternative for each group (Whitney and Maclaren 1985).

If a weighting scheme is used, sensitivity analysis should be conducted upon the results of the evaluation. This will indicate how sensitive the impact evaluation is to changes in the weighting used. If the results of the evaluation are easily altered by different weightings then less credence should be given to the results, alternatively if the results are relatively stable then this should be noted as support for the evaluation.

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4 1. Reducing the number of alternatives as well as the number of ECs that require evaluation (Maclaren and Whitney 1985).

2. Reducing the evaluation effort by removing an EC from evaluation if we can identify cases were an environmental component has either a similar magnitude of significant impact on all alternatives or an insignificant impact on all alternatives (Maclaren and Whitney 1985).

3. Reducing the number of alternatives by removing those that have exceeded a preset impact significance standard or criteria level for an environmental component (Maclaren and Whitney 1985).

4. Reducing the number of alternatives using dominance analysis. With this technique an alternative is said to dominate other alternatives if it has lower impacts in one or more ECs. At the same time the alternative must be "no worse" than other alternatives when considering all other environmental components (Maclaren and Whitney 1985).

Several other methods and techniques of evaluating alternatives have been developed (eg., decision analysis, multi-attribute decision making). Many of these methods have commonly been used as part of larger project oriented EAs. In many respects they were and are required because of the vast number of impacts related to these projects. The use of aggregation, decision analysis or multi-attribute decision making methods enable decision makers to make difficult tradeoffs between alternatives. However, the limited number of impacts related to most DSM programs do not require these techniques. Exceptions where these techniques could be useful are EAs that consider so many alternatives that their comparison is difficult. In that case one of the more complex methods (e.g., decision analysis) or the reduction of alternatives through pre-screening might be necessary.

3.1.2.5 Mitigation

Mitigation is the reduction or elimination of impacts upon environmental components. There are various types of mitigation that include changes in design, process, location, raw materials, impact control measures, remediation of environmental damage, and compensation.

The assessment should provide a rationale for the mitigation selection as well as seek the opinions of all relevant groups if it is to alleviate those groups' concerns about impacts of a project (Whitney and Maclaren 1985).

Determining who is responsible for the impacts and mitigation is a difficult issue in regards to DSM programs. Utilities promote the use of specific technologies, but the final decision to use them rests with the user, or more accurately the person who chooses to participate in these programs. If one employs the "polluter pays principle", the person who makes the decision to use that technology is the one who should be responsible. However, there is another side to this issue. As mentioned earlier, often the utility is only accelerating the adoption of energy efficient technology that was already occurring.

The suggestion that the program participant accept responsibility is premised to some degree on the participant being fully informed about the potential dangers or problems in using a product or type of technology that utilities are promoting. Not all participants are likely to be so well informed. In several jurisdictions this has been acknowledged. The U.S. Environmental Protection Agency and electric lighting manufacturers are developing labeling requirements for fluorescent lamps that indicate the type of lamp, its energy saving qualities, and its disposal options (MOWM 1993:25). In other cases, the utilities are informing and restricting the type of product that can be used in a DSM program (e.g., Manitoba Hydro's Energy Efficient Lighting Program specifies that only non-PCB ballasts can be used).

The acceleration of the introduction of these technologies raises the issue of whether the management infrastructure, regulations and level of information is maturing at a rapid enough rate to keep pace with any impacts. The usual slow response of government may make the problem worse than it needs to be. Therefore either the pace of the introduction of new technology through DSM programs should be slowed, or the utility should encourage government to move more quickly to inform the public and to manage and/or to regulate any of these impacts before they endanger or hamper the success of these programs.

A related issue is that, from a customer relations and corporate citizenship perspective, the utility may be wise to consider the benefits that can accrue from being in a leadership position with regard to these environmental impacts, regardless of the utilities' lack of responsibility for the impacts and their mitigation. While it is true that on balance most DSM measures produce net positive environmental benefits, these benefits can vanish if programs lose participants because of the generation of relatively minor but still real environmental problems due to feedback effects (Section 2.4.3).

3.1.2.6 Monitoring

There are two main types of monitoring: compliance and effects monitoring (Whitney and Maclaren 1985). Compliance monitoring determines the degree to which "...mitigation and operating guidelines specified in the EA" of a project or program are being met (Whitney and Maclaren 1985:20). Effects monitoring considers the effects of a project or program and seeks confirmation of predictions or hypothesis made in the EA as well as determining the success of mitigation measures. The public has a role to play in both compliance monitoring and in contributing its concerns about program impacts and mitigation effectiveness (Whitney and Maclaren 1985). Alterations to existing, or creation of new mitigation measures or operating guidelines can be a result of these monitoring measures.

Environmental assessment monitoring programs commonly create large amounts of data, often with little influence on either mitigation or the EA. Several suggestions have been made to address these problems. In general monitoring programs can be less of a drain on resources, and therefore more attractive to perform if they are “well defined and focussed” (Beanlands and Duinker 1983). In addition, effects monitoring can be more efficiently used if it is directed at areas most needing protection or least understood (Beanlands and Duinker 1983).

The need, degree and type of monitoring employed in a DSM program depend largely upon the set of impacts being studied. Since DSM program performance is monitored in order to make adjustments to programs, impact monitoring could be part of this existing monitoring process (e.g., monitoring CFC refrigerant being recycled as part of a DSM program). More directed research could perform hypothesis tests towards understanding specific impacts of concern (e.g., determining the impacts of mercury in landfills).

3.3 LEGISLATIVE EA REQUIREMENTS AND TRENDS

In Canada the federal and provincial governments have created legislation that requires environmental assessment of certain activities. However, the federal legislation has little applicability regarding DSM programs since both the activity and the jurisdictions where these activities occur are limited. The legislation applies to a physical activity where federal licenses or permits, lands or money are involved (Appendix B). This is unlikely to be the case in relation to a DSM program administered by Manitoba Hydro. For this reason this discussion will primarily restrict itself to Manitoba legislation including possible changes that may be expected based on existing or anticipated legislation in other regions (see Appendix B for a full discussion of EA legislation).

The environmental assessment process in Manitoba is set out in the *Environment Act* (Statutes of Manitoba 1987-88,C.26). This is a licensing process that involves environmental assessment only for specific types of projects. A whole range of lesser actions may be first required of project proponents. These actions include obtaining additional information about a project, requiring further study by the proponent, requiring detailed plans regarding environmental protection and management, requiring public meetings or hearings, providing guidelines and instructions to a proponent for performing environmental assessment including public consultations, or requiring a review of the assessment report. Any number of these actions may be required from proponents depending upon the class of the project, the judgement of the Director and in some cases the Minister.

This process is project driven; it defines developments as “any project, industry, operation or activity” or “any alteration or expansion of any project, industry, operation or activity which causes or is likely to cause” a number of effects (sec.1(2)). These effects include the following: using a technology for resource use that may cause environmental impacts; the use of a natural resource that may affect the use of that resource for other purposes; the release of a pollutant, industrial by-products, or wastes into the environment; effects on unique, rare, or endangered features of the environment; a significant effect on the environment either through the initial or a later development; and lastly significant effects on the social, “environmental health”, or “cultural conditions” of people (sec. 1(2)).

A regulation created under the Act known as the *Classes of Development Regulation* (Man. Reg., 164/88) provides a list of class 1,2, and 3 developments that are required to seek licenses in order to proceed. The discretion to place a specific development into one or another class is that of the director and is determined on the basis of the “examples or the criteria or both” for each class as listed in regulations (sec.1(2)).

Developments within class 1 are those whose effects are primarily related to the release of pollutants; these are typically cement plants, grain elevators, foundries, among others (*Classes of Development Regulation,* Man. Reg., 164/88, sec.2). Class 2 developments are those whose effects are not primarily related to the release of pollutants; these include mines, smelters, recreational developments, electric generating stations (less than or equal to 100 MW), some hydro-transmission lines, among others (sec.3). Class 3 developments are developments whose magnitude or whose number of environmental impact "issues" make them "exceptional projects" (sec.1(2)). Examples of class 3 developments include electric generating stations (greater than 100 MW), mining facilities, some transportation and transmission corridors, as well as large water developments (sec.4). There is some flexibility in allowing developments to be moved from class 1 to class 2 and from class 2 to class 1 or 3 if the Director feels it is appropriate (secs.10(6),11(8)).

Although the Manitoba environmental impact assessment process is project driven, and policy and programs do not presently receive environmental assessment, there are two possible approaches for the assessment of the provincial utility's energy plan. The first is that the utility could voluntarily submit the power resource plan to the assessment process; another option that is currently being considered is that the need and justification of the plan should be discussed, although possibly outside of the environmental assessment act (Strachan 1993).

In Canada the legislation of Ontario is the sole example where DSM programs have undergone EA (Appendix B). The Ontario *Environmental Assessment Act* requires that alternatives to an undertaking be considered by the EA, and in this case DSM is an alternative to developing supply-side resources (Doyle 1993).

Outside of Canada DSM programs have not been so extensively adopted with the exception of the United States. For this reason it is not surprising that the United States appears to be the primary place where DSM programs undergo EA. Moreover, the *National Environmental Protection Act* (NEPA) requires that "major federal actions significantly affecting the quality of the human environment" receive EAs (Douglas n.d.:27). The Bonneville Power Administration (BPA) in the Northwestern part of the country has submitted several of its DSM programs, as well as power resource planning documents, to an EA process (Appendix B). In the Netherlands, about thirty policy, program or plan environmental assessments have been completed (Seijffers 1992). The primary focus of these environmental impact assessments was regional waste management plans, regional plans for extraction of sand and gravel, a ten year waste management plan, electricity supply plan, and a drinking and industrial water supply plan and program (Seijffers 1992).

At both the federal and the provincial government levels in Canada the director of the department in charge of environmental assessment has the final decision on which project will require an EA. The director is aided in this decision by lists that suggest, exempt, or mandate assessment for a particular activity. However, these lists can be changed and the legislation often allows them to be overridden should the director consider it necessary. If concerns over the impacts of energy conservation programs were expressed to a sufficient degree it is possible that these programs could be required to produce environmental assessments. Given the non-serious nature of the impacts related to DSM programs it is unlikely that DSM EA would become mandatory. It is more likely that the long-term power resource plan of any utility may become the object of criticism by the public and interest groups should controversial energy options be contemplated. In this case, DSM, as part of the resource plan of many utilities will be assessed.

An example of an EA of a resource plan is the assessment of Ontario Hydro's supply plan. It may be that the controversy regarding this power plan was only a trigger for the expansion of the assessment process to considering plans and programs. Ontario seems to be continuing on the path to assessing large plans and programs such as Ontario Hydro's power resource plan under its *Environmental Assessment Act.* It is in the interests of a proponent to do plan assessment both to identify mitigation at an earlier stage and possibly to avoid the need for individual project assessments and to allow compliance and control legislation to deal with emissions and other impacts (Doyle 1993). Newfoundland has the ability to do so under its present legislation but has failed to exercise any of the powers as yet (Appendix B).

The application of EA to programs and policies as well as private sector projects has been slow, both in Canada and the World. Beyond the flexibility available to provincial and federal governments in applying existing legislation there is the possibility that legislative changes may occur in the future. Another possible route for the evolution of EAs could be the addition of separate processes specifically designed for less site-specific assessments. It was suggested that the present EA process was not an appropriate method for looking at the long-term energy plan of a utility (Blouin 1993, Gordon 1993, Strachan 1993). As mentioned earlier, Manitoba is exploring the idea of changing or adding to its assessment process in order to consider the energy supply/demand plans of Manitoba Hydro.

3.4 CONCLUSIONS

The potential components and characteristics of an EA were discussed in relation to their possible use in a DSM EA. The general framework for an EA that has been considered in this chapter is a starting point in the development of a more detailed framework for performing DSM EAs. A large number of factors need to be investigated to continue the framework's development.

Many countries are moving towards greater requirements for EA of programs as well as projects, however these requirements may not be part of the traditional process. Instead several observers suggest that the power resource plans of utilities and their DSM programs may receive a type of EA outside of the traditional process (Blouin 1993, Gordon 1993, Strachan 1993). DSM programs are required by the province of Ontario to be indirectly assessed for environmental impact as part of the Ontario Hydro power resource plan, this is the sole case in Canada. Presently there is no legislative requirement for the EA of DSM programs in Manitoba. Although changes to legislation and the EA process in Manitoba are inevitable, the form of such changes may occur outside of the present process. The lack of any legislative requirement for the EA of DSM programs means there is also no legislative guidance for performing an EA.

The power resource and demand side management planning process both need to be discussed in order to determine their strengths and weaknesses. There is also a need to consider the DSM EA activities of other utilities. Each of these two areas will be addressed in the next two chapters.

CHAPTER 4
APPLICATION OF EA TO POWER RESOURCE AND DSM PLANNING AT OTHER UTILITIES

4.1 INTRODUCTION

In the discussion of EA legislation, the requirements for EA in other jurisdictions were discussed with the purpose of discerning trends in EA legislation. Innovations in one place can eventually become common practice in another and a similar argument can be made regarding utility EA practices. By investigating the EA processes of other utilities, knowledge can be gained about innovations and trends in EA.

A survey of 155 electrical utilities in Canada, the United States and elsewhere was used to determine current and anticipated practice of DSM program environmental assessment (EA). Detailed survey analyses, responses, and a survey sample are provided in Appendix C.

4.2 CURRENT PRACTICE OF OTHER UTILITIES - SURVEY SUMMARY

4.2.1 EA CHARACTERISTICS

4.2.1.1 Types of EA

The survey indicated that there are four general types of EA that are being used by utilities on their DSM programs. They differ in terms of the breadth of the issues they examine as well as the detail in which this is done. Many of these are not traditional types of EA, but they are being used to accomplish one of the main objectives of EA - determining environmental impacts and including them in the decision making process. Each of these types of EA was reported in use by at least two utilities except for the second type which was noted by only one. The four types are are the following:

1. EAs used as a planning tool that compare demand and supply side resources in order to limit environmental impacts; this can be both quantitative and qualitative. It can be part of the integrated resource assessment that determines the emissions of different power resource plans. It can also be part of a national program to reduce the environmental impacts of all utilities.
2. EAs as a mechanism for determining environmental externalities used to find the true cost and cost-effectiveness of DSM programs to the utility and society.
3. A DSM program or issue-oriented EA where a program is studied in relation to any of its perceived environmental impacts. This type of assessment usually determines the seriousness of a problem, the regulations or liability which apply, and considers possible mitigation measures. It may consider any or all of these issues related to that program.
4. Issue-oriented EAs that consider an issue related to all resources, both supply and demand. Examples have been given of assessments of trends in environmental regulations.

Two even less traditional EA variants were suggested. One respondent identified EA as a marketing tool that provides the information required to motivate people to participate in DSM programs. Another indicated it as a means of promoting the proper management of hazardous wastes.

4.2.1.2 Placement in the Planning Process

Utilities performed EAs at various places in the planning process. Whether or not utilities had performed EAs they indicated an increasing preference for EA as the planning process progressed from the power resource plan, through the overall DSM program plan, to the individual DSM program plan (Figure 2, 3). One utility performed EAs for all DSM programs. Very few utilities indicated that their EA was a multi-stage or tiered process. Within the group of utilities performing EAs, it was noted that a program needed to reach some degree of development in order to perform or complete an EA. It was noted by one utility that initial designs may take into account some environmental aspects that may receive further consideration later. It can be concluded that most EA is occurring at one place in the planning process for those utilities performing EAs of DSM programs.

4.2.1.3 Objectives

The objectives of EAs included determining the environmental impacts of programs and cost-effectiveness of a program (including environmental externalities), promoting participation in DSM programs and disposing of wastes in an "environmentally sound" manner, ensuring the health of participants, obtaining information

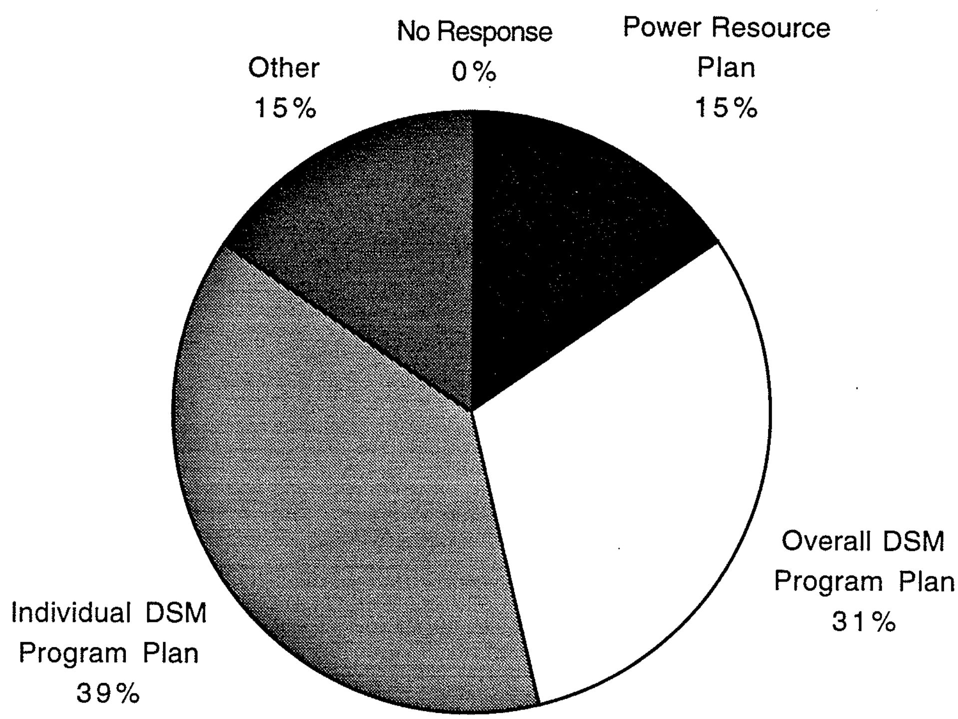

Figure 2 **EA placement in the planning process EA Respondents (Question B-6)**

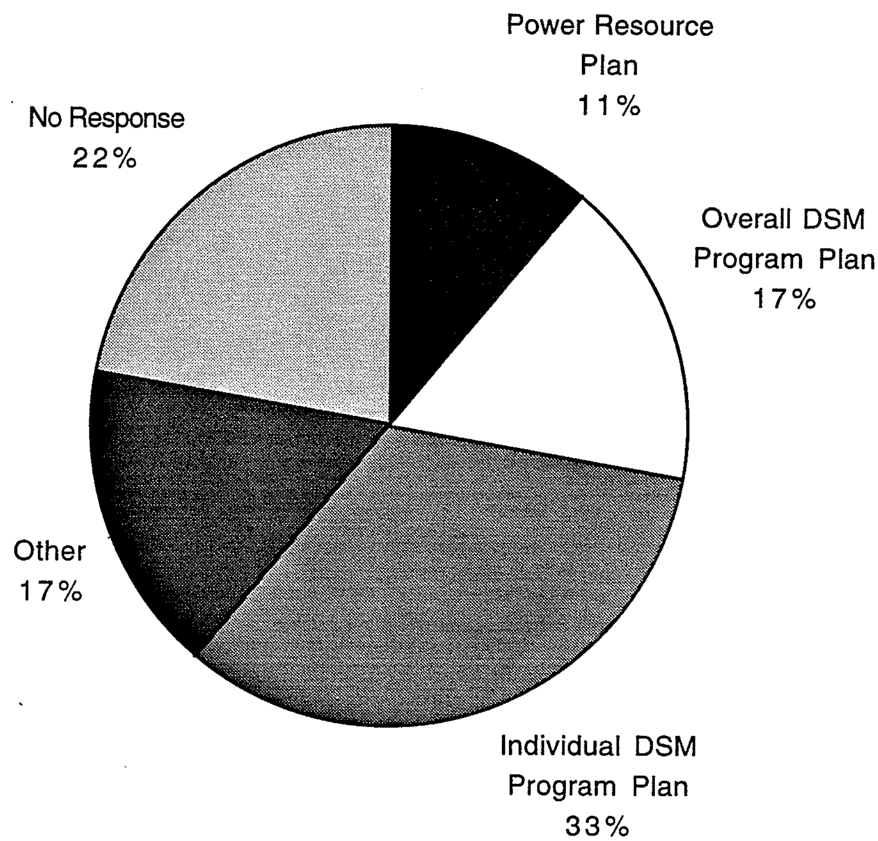

Figure 3: **<u>EA placement in the planning process Non-EA Respondents (Question C-9)</u>**

about the legal, regulatory and waste management practices as well as the available infrastructure related to program management.

4.2.1.4 Flexibility

There was no indication from respondents that the EA should be flexible in terms of the range of program scales, of program or impact types, or of program situations to which it could be applied.

4.2.1.5 Resources Required

Survey respondents indicated that staff and monetary resources were limited for doing EAs. This suggests that EA methods that require the fewest resources will be utilized most often.

4.2.2 SCOPING

Most survey respondents indicated that they would use the service area of each utility as the spatial boundary, although a better method was suggested: letting the impact determine the boundaries (eg., sulphur dioxide emission from thermal power plants would be assessed beyond a countries boundaries since the impacts are often transboundary). It is likely that using a combination of both methods would be best.

4.2.3 IMPACT IDENTIFICATION

No specialized impact identification techniques were indicated by survey respondents.

4.2.4 IMPACT PREDICTION

No specialized impact prediction techniques or methods were indicated by survey respondents.

4.2.5 SIGNIFICANCE ASSESSMENT

The method mentioned in the survey for assessing the significance of impacts included consideration of both regulatory levels and baseline conditions.

4.2.6 EVALUATION OF ALTERNATIVES

There was only a limited indication that alternatives are presently being considered, although in the evaluation of impacts, the primary methods used were ad hoc committee, tabular comparison of alternatives, and cost-benefit analysis. No utilities suggested that DSM equipment manufacturers be required to perform life cycle analysis of their DSM products; however, two utilities indicated they performed life cycle analysis and others considered this a possibility should they perform assessments.

4.2.7 MITIGATION

The survey indicated that mitigation would likely be a utility responsibility regarding implementation (Figures 4, 5), funding, and monitoring; however, the public, industry and government may be responsible depending upon the type of program and the measures implemented. Mitigation measures that were identified included the recovery of CFCs from discarded refrigerators.

4.2.8 MONITORING

Respondents indicated that the utility would be involved in monitoring the impacts of DSM programs.

4.2.9 PUBLIC CONSULTATION

Respondents to the survey include the public in the EA of DSM programs primarily through a public hearing process. A public hearing is a legally mandated part of either the EA or the utility planning process in some jurisdictions. Actual public involvement in an earlier stage is not common.

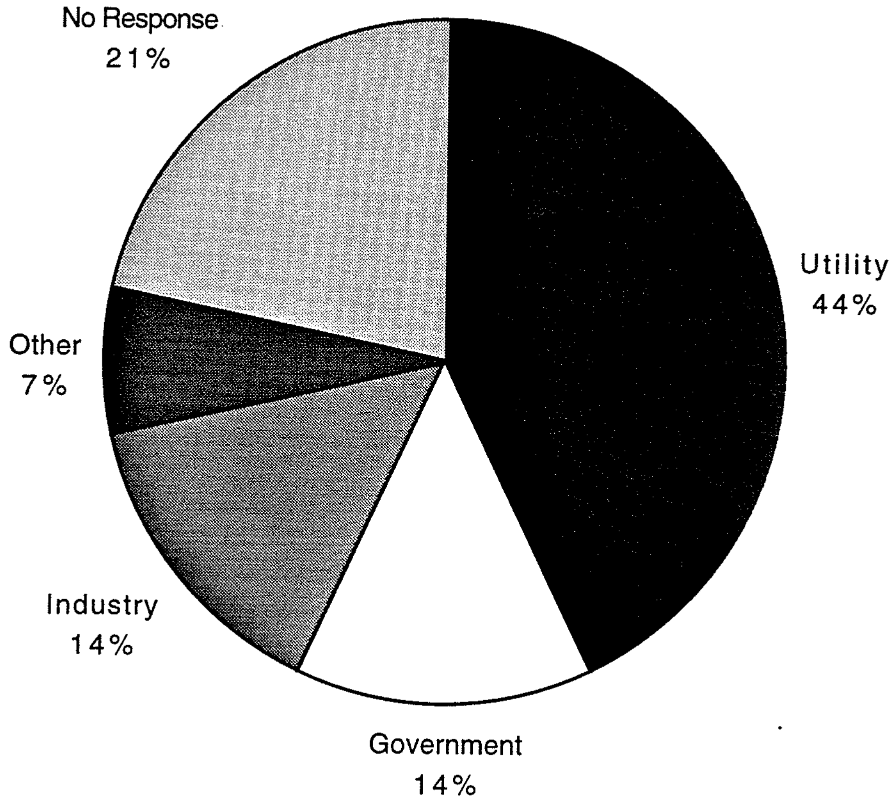

Figure 4: **<u>Responsibility for implementing mitigation EA Respondents (Question B-16)</u>**

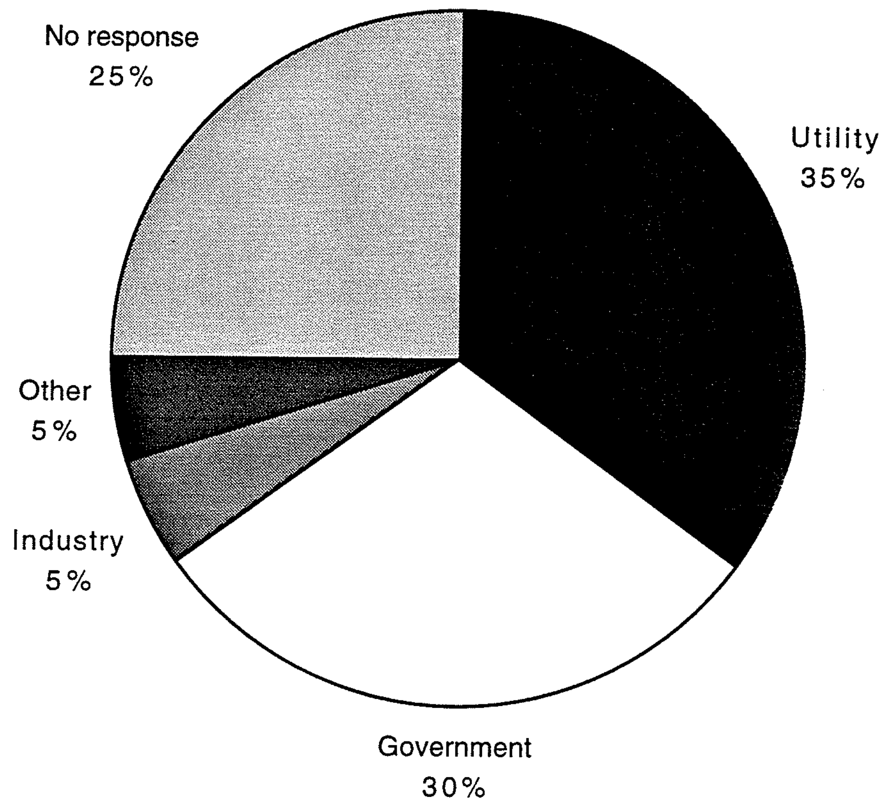

Figure 5: <u>Responsibility for implementing mitigation Non-EA Respondents (Question C-27)</u>

4.3 CONCLUSIONS FROM SURVEY

The survey results provide few definite conclusions regarding DSM EA. Some of the more interesting insights are valuable to the evaluation of the present EA process and development of a DSM EA framework. A wide variety of EA types are being used as well as suggested for possible use by a small number of utilities.

Four general types of EA are being used by utilities on their DSM programs. Many of these are not traditional types of EA, but they are being used to accomplish one of the main objectives of EA - determining environmental impacts and including them in the decision making process. The four types are the following:

1. EAs used as a planning tool that compare demand and supply side resources in order to limit environmental impacts.
2. EAs used to determine the environmental externalities of DSM programs.
3. DSM program or issue-oriented EA where a program is studied in relation to any of its perceived environmental impacts.
4. Issue-oriented EAs that consider an issue related to all resources, both supply and demand.

Utilities indicated that responsibility for implementation and funding of mitigation rested with the utility and to a lesser extent government and industry. The degree of public involvement remained limited unless it was mandated by a public hearing process. Although utilities appear reluctant to include the public directly, indirect involvement through a survey of public opinion or focus groups would be a possible way of increasing public input in a DSM EA. Unlike other utility power resources DSM programs are very dependent on public participation; public input at an early stage can only benefit a DSM program.

There is limited use of EA tiering (multiple stage EA) among utilities. Those utilities performing EAs of DSM programs do so mainly at the later stages of the planning process, specifically during the development of the overall DSM program plan and individual DSM programs. The survey indicated that life cycle analysis was being performed by two utilities while none suggested that the manufacturer of the DSM products should be required to do so.

A general conclusion that can be drawn from the survey is that Manitoba Hydro is largely at the same level of development of DSM program EA as other utilities performing DSM program EAs. Manitoba Hydro and these other utilities both indicate some EA at a single stage of the planning process. However, Manitoba Hydro is performing its DSM EAs during the development of the power resource plan (Section 5.2) which is earlier in the planning process than most EAs of other utilities.

The area of the questionnaire that was answered most poorly were those questions that dealt specifically with the identification, prediction, and evaluation stages of EA. Several examples of program EAs discussed in Appendix D provide a number of useful means of approaching these parts of an environmental assessment. These will be introduced later in chapter six.

CHAPTER 5
MANITOBA HYDRO'S POWER RESOURCE AND DSM PLANNING PROCESS

5.1 INTRODUCTION

To determine the appropriate framework for the EA of DSM programs it is important to discuss both the power resource and DSM planning process and the EA that is a part of that process. One result of the research into the power resource and DSM planning process was a realization of the size and hierarchical nature of the planning process. It was felt that determining the scope of a new EA framework by considering only the DSM program development stage would be inadequate. To avoid this problem the discussion and evaluation extend beyond considering the DSM program development stage to consider the wider power resource and DSM planning process.

5.2 DESCRIPTION AND ANALYSIS OF PLANNING

5.2.1 OVERVIEW

The power resource planning process at Manitoba Hydro can be broken down into several stages. The first stage of the process includes the preliminary economic screening of a large number of supply and demand resource options (Hamlin, March 23,1993), for example, on the supply side coal-thermal power plants or gas combustion turbines, and on the demand side, varying levels of DSM.

This first screening is followed by detailed economic evaluations of the more competitive resource options (Hamlin, March 23,1993).

DSM program options were evaluated through a qualitative screening, technical potential screening, and economic screening. The economic screening considered cost-effectiveness primarily through one of two means. The Total Resource Cost (TRC) test assessed the "net energy and capacity savings, the avoided costs of customers, and the program costs paid by both the utility and the participant". This test did not include incentive payments to participants or monthly fund transfers through customer utility bills. The Rate Impact Measure (RIM) was the other measure of cost-effectiveness. This test determined "how long-term rates change as a result of the program compared to the base case (no program)." The test measures all program costs and revenue losses (Barakat & Chamberlin 1991:II 13-25). The first stage results in the production of a power resource plan phase I report that includes a preliminary recommendation regarding the DSM level and supply option in service dates.

The next stage of power resource planning continues with benefit/cost screening of DSM program options to form program groups that have demand reduction levels in planning increments (e.g., 100, 150, 200, 250 MW etc.). Resource sequence studies are done to determine the impact of different supply option in service dates with various DSM levels and other resource options (e.g., combustion turbines, life extension of thermal power plants, re-runnering of older hydro-electric turbines) on meeting energy demand requirements. In addition a financial and qualitative environmental evaluation of some of the more competitive resource sequences is produced. This stage results in the production of the power resource plan phase II report that includes a recommendation for a resource sequence that recommends a DSM program level and in service dates for supply resources as well as other resources (e.g., life extension for a thermal generating station).

After the phase II report the next stage of the process involves further planning that occurs for both the supply and demand options that have been chosen. Data on the avoided costs of the DSM programs are used to further screen individual programs within the DSM program level that has been recommended. This phase culminates with the production of a long range plan that outlines the intensities and types of programs within the overall DSM program.

Following the development of an overall DSM program plan is the development of individual DSM program plans. In terms of DSM there is actually little in the way of an end point to the planning process. Since DSM programs do not involve large capital investments they are monitored and adjusted to suit market conditions (Akrestream 1993). However, the planning process for supply resources does reach an endpoint when the report *Overview of Selection of Next Resource Addition* is produced. This report considers the options for the next resource developed prior to the final decision. The evaluation is broad based encompassing socio-economic, corporate economics, environmental, financial, system, and risk analysis perspectives. Recommendations for next resource addition are made for different system scenarios. Scenarios include various combinations with and without power sales and diversity exchanges. These resources may include all power resources but emphasis is placed on supply resources at present.

Some of these planning stages are performed annually and others only when required. The power resource plan is reviewed and updated annually. The evaluation of the next resource addition occurs only when required.

Over the course of the planning process other reports that have not been mentioned may contribute to the process. However, these are the primary components of the planning process that lead to the recommendations for resource acquisition when approved by the corporation.

5.2.2 DECISION BREAKDOWN

The main structure of any planning process involves the determination of a set of goals or objectives. In order to meet these objectives, various alternative means are evaluated. Each planning process has within it a number of events which mark the reduction of alternatives from a large set to a smaller set until eventually one or more alternatives are chosen to meet the predetermined set of objectives. These "decision events" can be identified as moments when a selective process reduces the number of alternatives actively under consideration. Decision events are important because they represent the primary places where information is required to make choices in the planning process. It is at these points that environmental evaluation will provide the maximum degree of contribution to the decisions being made.

There are five main decision events within the power resource planning process (Table 2). The first involves deciding what resource options are included in the preliminary evaluations. Once this broad set of resource options is determined, the process proceeds to reduce their number in the second decision event. Here a short-list of resource sequences are chosen to receive further more detailed analysis. In the third decision event the preferred resource sequence is selected containing a specific DSM program level, supply resources, in-service dates and with recommendations on other resources. The fourth decision event occurs with the development of the overall DSM program plan within the designated DSM level. The development of the individual resource plans marks the fifth decision event; here plans are designed and finalized. These resource plans could be for specific DSM programs, or in the case of a supply resource, the recommendation for the next supply addition. These events are followed by implementation of the DSM program or the acquisition of supply.

5.2.3 SUMMARY

The placement of EA in the planning process is an important determinant in an EAs success as well as its usefulness. One way of finding the correct place is consideration of the major decision events in the planning process and assuring that environmental analysis is integrated into these events. In this way the appropriate level of

Table 2: Planning Process and Decision Events

STAGE OF PLANNING PROCESS		DECISION EVENT
Preliminary evaluation and selection of supply/demand options.	1	*Selection of initial resource option set.*
Detailed evaluation of supply/demand options from initial power resource option set. • Power Resource Plan Report - Phase I	2	*Screening of resource option set.*
Continued evaluation of supply/demand options. • Final screening and selection of power resource sequence. • Power Resource Plan Report - Phase II • Report reviewed and updated annually.	3	*Final Selection of power resource sequence.* • Target DSM level and in-service dates for supply resources.
Development of DSM program plan. • Final screening and selection of DSM programs. • Long range DSM plan report. • Report reviewed and updated annually.	4	*DSM program plan completed.* • Intensities/types of DSM programs.
Development of individual power resource plans: • Evaluation of next resource addition options. (Supply options at present) • Performed when required.	5	*Finalization of individual demand/supply resource plans:* • Selection of next supply resource to be developed.
Development of individual DSM program plan (Demand options). • Performed when required.		• Completion of individual DSM program plan.

analysis will occur before resource option alternatives (supply and demand options) have been limited by a decision.

Five main decision events were identified for Manitoba Hydro's power resource planning process: selection of the initial resource option set; the screening of the resource option set; the selection of the power resource sequence; the completion of the DSM program plan; and the finalization of individual demand/supply resource plans. Each of these decision events is preceded by changing environmental analysis needs. It is these needs and the degree to which they are met that will determine whether any changes are required in the planning process.

5.3 CURRENT EA PRACTICE AT MANITOBA HYDRO

The various DSM programs that have been considered by Manitoba Hydro have been given a preliminary qualitative impact assessment by Barakat and Chamberlin as a contributing study to the qualitative EA of power resource options in the *1991 Power Resource Plan - Phase II Integrated Demand/Supply Option Evaluation* (Manitoba Hydro 1991: Appendix G). This EA occurs prior to decision event three, the selection of the power resource sequence. The sources of impacts are discussed and the impacts are given on a program by program basis for different general environmental attributes. Positive and negative impacts were indicated in the evaluation of the proposed DSM programs.

The Industrial Retrofit Program provides an example of a DSM program; it includes such measures as the replacement of older lighting, HVAC (heating, ventilation, air conditioning), motors, and control equipment with newer energy efficient equipment. In its evaluation a number of impacts are ascribed to this program. These include positive impacts on public health and safety due to decreased escape of mercury and polychlorinated biphenyls (PCBs) from lighting equipment through safe disposal measures. Other positive impacts on public health and safety include improvements in eye health due to increased lighting levels. Negative impacts include premature introduction of the lighting equipment into the waste stream.

Other programs that were discussed include the Commercial Retrofit program, Comprehensive Efficiency Improvement program, Energy Efficient Appliances program, Energy Saving Light Bulbs program, General Service Curtailable Rates program, General Service Dual Fuel program, General Service Standby Generator program, HVAC Remodel & Replacement program, Lighting Remodel & Replacement program, and Motordrive Replacement program. Each program was evaluated in relation to potential impacts on public health and safety, livelihood & way of life, disruption of important or scarce resources, long term - low level environmental effects, relocation of infrastructure and global effects. The same analysis is conducted with the assumption that the best available mitigation measures are implemented. This analysis lists only the negative impacts of programs that have not been reduced by mitigation measures.

The qualitative EA in the power resource plan includes an assessment of the emissions that could be eliminated if a specific power plant (132 MW Brandon Thermal Generation Station) were retired 9 years early through the introduction of 200 - 300 megawatts of DSM measures. The power resource plan also includes a qualitative analysis of environmental impacts between different levels of DSM programs, continued thermal power plant operation and the development of a new hydro-electric plant (Wuskwatim) on the Burntwood River in northern Manitoba (Manitoba Hydro 1991: ch. 7). The positive and negative impacts of these different programs and projects, assuming mitigation, are listed. A further step in the analysis is the ranking between similar types of demand and supply components (resources) according to their environmental impacts, such as between different levels of DSM programs. This ranking is conducted according to the following two rules (Manitoba Hydro 1991:42):

- less of the component is preferable to more.
- later development of the component is preferable to earlier.

The rankings of the DSM programs result in less DSM being preferable to more, because DSM programs on balance have slightly negative impacts. Similarly, because of negative impacts, earlier thermal power plant retirement and later Wuskwatim development are also preferable.

The next step in Manitoba Hydro's analysis is intercomponent ranking, which the report notes as being difficult because of the differences between the types of impacts of various demand/supply resources. The considerations used in the analysis are the category and diversity of any impacts. Impacts on "public health and safety and on livelihood and way of life" are given a higher weighting and less diverse impacts are preferable to more diverse (Manitoba Hydro 1991:43). The intercomponent ranking indicated neither the DSM programs or thermal power plant operation had negative impacts in the two important areas noted above. They also indicated that impacts of coal operation are more diverse than those of DSM programs. DSM programs are noted as having some positive impacts on public health and safety due to their fostering of proper disposal practices for PCBs and mercury containing lighting equipment. Finally, it indicates that the Wuskwatim development has a diverse set of impacts that include impacts in the more heavily weighted areas.

The analysis concludes that the two highest levels of DSM programs are preferable because of their ability to allow early retirement of the thermal power plant in Brandon and later development of the Wuskwatim hydro-electric facility. They indicate that comparison between Wuskwatim timing and the DSM program level is prevented by the small difference of one year in the Wuskwatim in-service date.

While the EA takes a strictly provincial viewpoint in relation to environmental impacts, it does define when the consideration of other impacts would influence rankings and recommendations. Two areas of out-of-province impacts could be considered: environmental impacts from coal production in Saskatchewan, and environmental impacts on air in the North Central United States and Ontario where power diversity exchanges occur between Manitoba Hydro and other utilities. Taking these two areas of impact into account would shift the decision in favour of the most aggressive levels of DSM programs since these levels of DSM would reduce the impacts from supply resources located both inside and outside of Manitoba, supply resources required to meet demand in Manitoba and in regions which Manitoba Hydro has power diversity exchanges.

After this stage of EA, the DSM programs do not receive further EA; however, this is not the case for other power resources. Supply resources that are under consideration as the next resource addition receive another environmental evaluation in the *Overview of Selection of Next Resource Addition* (Manitoba Hydro 1989). This EA occurs at decision event five, the finalization of individual demand/supply resource plans. This event involves the selection of next supply resource to be developed as well as the completion of individual DSM program plans. This is a qualitative EA that is similar to the EA in the power resource plan with a few exceptions. It focuses on the next resource addition, which at present does not include DSM. Environmental impacts are discussed using two approaches.

In one approach a "direct comparison" is made between the environmental issues of the different projects (e.g., Wuskwatim, Conawapa, Bipole III) that may be "problematic or advantageous" in the opinion of interest groups and those affected (Manitoba Hydro 1989:4-2). The impacts are categorized and presented similarly to the EA in the power resource plan (e.g., Public Health and Safety, Disruption of Livelihood and Way of Life), however the impacts are described in greater detail. This approach compares the "relative extent"[1] that each of the resources may produce "problematic or advantageous" environmental issues (Manitoba Hydro 1989:4-3).

The other approach is the "first plant comparison". This approach compares the "potential environmentally related advantages" of developing two hydro-electric facilities in different sequences, while assuming that both would be developed in the near future (Manitoba Hydro 1989:4-6). The objective of the comparison is to decide what plant it would be preferable to develop first from an environmental perspective. This is a similar approach to that used in the "intercomponent ranking" in the power resource plan EA with the exception that more emphasis is placed on the timing of impacts than their category and diversity. Another difference is that the power resource plan EA considered a wider group of alternatives than did either the "direct comparison" or "first plant comparison" EA approaches.

This evaluation also extrapolates the potentially problematic impacts of resource sequences for three different scenarios, no additional power exports (base case), a diversity exchange agreement, and a diversity exchange agreement in addition to an export agreement.

In addition, following the decision regarding the next resource addition, new generation, transmission, and transformer facilities will receive individual assessments mandated by *The Manitoba Environment Act* (S.M. 1987-88 c.26.) prior to licensing.

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[1]The "relative extent" of impacts are compared rather than performing a direct comparison because they suggest that information on impacts is both "uncertain and incomplete". Information for doing such a comparison will be acquired through environmental impact assessments conducted for each project.

This section has outlined the current approach to EA that is used on DSM programs as well as other power resources in the power resource plan. There are several ways that the present EA process could be improved upon: earlier EA and more detailed EA at a later stage in the planning process are two possible changes. A full discussion of the limitations of the EA within the planning process is necessary to reach any conclusions about possible changes.

5.4 EVALUATION OF MANITOBA HYDRO'S EA OF DSM PROGRAMS

There are a number of limitations related to the present level of environmental analysis provided in the power resource plan where possible solutions are indicated (Table 3). Although comments will be made regarding the EA of supply resources, the focus of the evaluation will be the EA of DSM programs.

It has become a widely held view in the environmental assessment community (Grove-White 1984, Holling 1978, Economic Commission For Europe 1991) and through environmental assessment legislation (U.S. NEPA - Sigal and Webb 1989, *Canadian Environmental Assessment Act* S.C.1992, C.37) that consideration of environmental impacts needs to be done as early as possible in the planning process. There are a number of reasons for this. Chief among these is that it allows for a full consideration of alternatives before other factors have influenced their removal from any

Table 3: <u>Summary and Evaluation of the EA in the Current Manitoba Hydro Power Resource and DSM Planning Process</u>

	Decision event	Environmental analysis	Issues and Limitations	Conclusion
1	*Selection of initial resource option set.*	None	• No early consideration of environmental issues.	Long-Term Resource EA Required
2	*Screening of resource option set.*	None		
3	*Final Selection of power resource sequence.* • Target DSM level and in-service dates for supply resources.	Initial qualitative environmental evaluation.	• Quantitative analysis may be useful in certain circumstances. • No follow-up analysis of impact issues raised by initial env. analysis.	Quantitative Analysis Follow-up EA of DSM program impacts when required.
4	*DSM program plan completed.* • Intensities/types of DSM programs.	None	• No analysis of complete DSM program plan - prevents any adjustment to program type or intensity.	DSM Program Plan EA
5	*Finalization of individual demand/supply resource plans.* • Selection of next supply resource to be developed. • Completion of individual DSM program plan.	• Qualitative/ Quantitative EA of Next Power Resource Addition. • DSM - None	Lack of analysis of DSM mitigation options and regulatory concerns.	EA of DSM • mitigation alternatives • regulatory issues

evaluation. One can see this manifested in the power resource planning process. Several screenings occur before a short-list of power resource options receives an environmental evaluation.

Power resources that have site-specific impacts (e.g., Hydro-electric facilities) are more difficult to include at these early stages in the planning process due to the lack of information. Presently supply resources receive environmental analysis during the screening of sequences (prior to decision event 3), during the next plant selection (prior to decision event 5), and again when an EA is required for environmental licensing. There is a need for earlier consideration of environmental effects so that the environmental benefits and costs of alternatives can be included before the initial screenings take place. In many cases this will have no effect on the group of alternatives that pass a screening. However, it is important that resource options not be evaluated on the basis of only economic considerations. The consideration of the environmental costs and benefits when most alternative power sequences have already been eliminated may reduce the analysis effort, but it also prevents some resource alternatives from being fairly evaluated using environmental as well as other factors. There are several means of including environmental considerations earlier. The most common means are the use of environmental externalities within the economic evaluation of power resources. A more thorough way that leaves the present process more or less untouched is an EA of power resource options for a specific period of time (similar in concept to the BPA resource analysis).

Another limitation of the environmental analysis is its use of only qualitative comparison of resource sequences. The "less and later analysis" that is used is based upon the premise that when a resource sequence component has mainly negative effects it is better to have less of that component than more and that is better to have these effects occur later rather than earlier (DePape 1993). This qualitative type of evaluation has several limitations. The ability of planners to make tradeoffs between the various economic and environmental aspects is limited unless the differences between resource sequence components is large. This becomes clear when one considers that the evaluation cannot distinguish which component is superior an increased level of DSM or a one year shift in the installation of the next two hydro-electric facilities (Manitoba Hydro 1991).

It is possible, though not probable that this limitation could be alleviated by quantification of some or all of the environmental components considered in this analysis. It is not likely that it would make a significant difference in the decisions being made, especially those involving site-specific resources where quantification of impacts is most difficult. However, quantification of impacts does have several other inherent strengths. One advantage of quantification is that it would allow the environmental analysis to become more objective and resilient to changes in assessment staff. Another advantage is the assessment of the non site-specific impacts of some resources (eg., DSM, thermal power plants, gas turbines), including the avoided supply-side impacts of DSM programs that are attributable to thermal power plants. These are perhaps the best examples of resources that produce quantifiable environmental changes (eg., carbon dioxide or mercury emissions from the combustion of fuel). The use of quantification for these resources may allow for more accurate decisions to be made between these resources. There may be a place for limited applications of quantification when especially difficult decisions are required involving these resources. The quantification of avoided supply-side impacts of DSM programs by Ontario Hydro is an example of a useful application of this approach that could be adopted by Manitoba Hydro (Appendix D). There are two other situations where it may be beneficial to use quantified analysis in relation to DSM programs: 1) when regulatory concerns are present; or 2) environmental costing is being used in the economic analysis of these resources.

Considering the present power resource planning process it becomes evident that should an environmental issue be identified regarding a DSM program or another power resource, there is no further level of analysis to consider the issue in greater detail. Presently, DSM programs are not included in the report *Overview of Selection of Next Resource Addition.* Therefore DSM programs do not receive the added environmental evaluation received by other power resources at this stage, as well as prior to environmental licensing. This has even greater importance should mitigation measures need to be investigated related to any program impacts. An EA at this point would provide an opportunity for evaluating any mitigation measures.

There is a need therefore for a type of environmental assessment that can consider issues of interest or concern that are related to DSM programs or other resources. This type of assessment could take different forms depending upon the issue that was being investigated. Several utilities indicated they were using such an issue-oriented assessment. These assessments had as objectives determining the impacts of DSM programs, determining possible mitigation measures, regulatory trends or liability issues.

This EA approach could be used anywhere within the planning process. Whether an issue is identified before initial screenings or after program implementation an assessment could be performed to investigate the implications of the program or issue. This type of assessment would not be a replacement for either a full supply resource EA or a broader power resource program EA, only a supplement.

After the power resource sequences have been selected the overall DSM program plan is finalized. This involves determining the type, number and levels of intensity of each DSM program that makes up the program block. It is at this level that the environmental evaluation of individual programs could be useful to indicate any problems or issues that may influence whether a program should be implemented and if so, how it would be implemented. At this time no such evaluation occurs.

Environmental analysis of the different programs after the level of DSM has been determined would enable planners to be selective regarding DSM programs that may have negative or positive environmental implications. Changes could be made to the programs selected, or their intensity or use of mitigation measures. In terms of negative implications, the programs and impacts mentioned in an earlier section (3.2) highlight the problems that may make one program more or less desirable to implement. On the other hand, although DSM in itself is relatively beneficial in terms of the environment, certain programs create the opportunity to improve the environment more than others. An example is an energy efficient refrigerator program that allows the utility to combine a DSM program with a recycling activity. Another possible example is the recycling of mercury containing lamps; while the DSM programs may contribute little in terms of added lamps to waste sites (often just accelerating lamp changeouts) these programs can serve as focal points for recycling programs that encompass other non-program lamp waste. Again, similar to refrigerant recycling a positive environmental impact is created out of a negative impact.

When the overall DSM program plan has been developed each individual DSM program plan is formulated. Along with the economic, administrative and technical aspects considered in the development of this plan it would be desirable to consider environmental concerns regarding specific programs. These concerns would ideally, but not necessarily, be identified in an earlier level of environmental analysis. At this stage of the planning process the primary focus of any environmental analysis should be related to the implementation of the program, since the decision to implement has already been made. This would mean that program guidelines, mitigation and regulatory requirements be considered. If these were insufficient to reduce the impacts then changes to program intensity or design could occur, including cancellation of the individual program in extreme situations. It was mentioned earlier that an issue-oriented assessment would be useful for considering environmental concerns related to programs or other resources. The same type of assessment could be applied to DSM programs at this level. The only difference is that the issues are likely to be mitigation and regulatory requirements.

5.5 CONCLUSIONS

Five main decision events were identified for Manitoba Hydro's power resource planning process: selection of the initial resource option set; the screening of the power resource option set; the final selection of the power resource sequence; the completion of the DSM program plan; and the finalization of individual demand/supply resource plans. Each of these decision events are preceded by changing EA needs. It is these needs and the degree to which they are met that will determine whether any changes are required in the planning process. The evaluation of the EA within the planning process has come to several conclusions about what is present and what is missing from the EA part of the planning process.

Manitoba Hydro performs limited environmental costing of some resources during the selection of the initial resource option set (eg. mitigation or compensation costs of hydro-electric facilities). In addition, qualitative EA of all resources occurs at the final selection of the power resource sequence. Afterwards, qualitative and some quantitative EA of supply options occurs during selection of the next supply resource to be developed. The selected supply resource receives further qualitative and quantitative EA prior to requesting an environmental license from the province.

There are many other areas where EA could supply further useful information for the planning and assessment of DSM programs. There is a lack of consideration of environmental issues at the early stages of the planning process prior to the selection of the initial resource option set. A broad based environmental analysis of long-term resource options would be useful at this stage to provide inputs to the option selection process.

The use of quantitative analysis may be useful in relation to DSM programs: 1) when regulatory concerns were present; or 2) environmental costing was being used in the economic analysis of resources.

No form of analysis is present to further consider issues raised about DSM programs by the initial environmental evaluation during the final selection of the power resource sequence.

There is no EA of the complete DSM program plan thus limiting possible adjustment of program type or intensity according to environmental impacts.

There is no analysis of DSM program mitigation options and regulatory concerns. Although impact concerns are not serious they have been addressed to varying degrees by other utilities. It would seem prudent that these issues also be considered by Manitoba Hydro.

The primary area of the planning process most in need of EA are the earliest and the latest stages. Specifically, before the selection of the initial resource option set and after the final selection of the power resource sequence.

CHAPTER 6
APPROACHES TO EA FOR POWER RESOURCE AND DSM PLANNING

6.1 INTRODUCTION

In the discussion of DSM in chapter three it was concluded that an EA of DSM programs would be useful to identify programs that have significant impacts and may require mitigation or monitoring. In addition, the survey established that several utilities are currently using different types of EA on their DSM programs, often applying EA at a later stage of the planning process than Manitoba Hydro. It is at this later stage of the planning process, as well as three other stages that several shortcomings were identified in the environmental analysis within the current power resource and DSM planning process at Manitoba Hydro. The development of a new EA approach to address these needs is the object of this chapter.

6.2 NEW EA APPROACH

There are numerous approaches that can be used to include environmental analysis in the power resource planning process. In the coming evaluation of these approaches each approach is listed alongside specific decision events. These EA approaches are expected to be used prior to those events in order to contribute to the decision being made. A set of criteria will be introduced to help evaluate and select the best approach(es) for the planning process.

6.3 EVALUATION CRITERIA

A few criteria need to be defined for the evaluation of EA approaches:

1. Does there exist adequate information to use this EA approach?
2. Is there adequate need for this new EA approach?
3. Does the EA approach require a significant commitment of resources?

The evaluation process involves testing each approach against the above criteria. These criteria are ordered in terms of their application to each approach. This means that the first concern is whether sufficient information exists, and so forth. The criteria and their order is related to the practicalities of doing any study. Without sufficient information the EA can not produce any meaningful results that can be used in the planning process. Sufficient information exists when an EA approach can either use generic information, or follows a preexisting study (tiering). If there is insufficient information there is no need to consider any other criteria and the approach is no longer considered.

It is difficult to judge the need for an EA, many EA approaches can appear to alleviate deficiencies in an existing planning process but the question is, at what point: does a new approach contribute sufficiently to make the changes worthwhile? Two conditions are suggested. If the approach involves adding another level of analysis then a significant deficiency must exist with the present analysis approach. If the approach involves an enhancement of an existing approach then the deficiency need not be significant. Again, if sufficient need is not identified then there is no point in considering further criteria and the approach is no longer considered.

The last criteria considers whether a significant level of resources is required. Although both information to perform the study and sufficient need may have been identified there may be no point in attempting the analysis if the staff or funding resources do not exist. A significant demand on resources occurs when a new EA approach is created. Other factors that come into play in terms of significance are the frequency of the approach and its scope of application. It must be remembered that this evaluation is looking at the development of a new EA approach and not the application of a specific EA. Otherwise, one could argue that individual instances may occur where the need for an EA would supersede deficiencies in other criteria. For example, greater resources could be made available to offset the lack of information by providing funding for supplementary EA studies.

6.4 DESCRIPTION AND EVALUATION OF EA APPROACHES

The following discussion will list the decision event(s) being considered and the related EA approach alternatives. This will be followed by a description of each approach, including their scope and objectives followed by an evaluation of the alternative EA approaches using the evaluation method and criteria developed in the previous section.

6.4.1 Decision Events 1 and 2:

1. Selection of initial resource option set.
2. Screening of resource option set.

Possible EA approaches:

- EA approach 1: Environmental externality costing.
- EA approach 2: EA of power resource options.

EA approach 1: Environmental externality costing

Description of EA approach:

The inclusion of environmental externalities in resource costing is a practice that is required in many U.S. states (Pace 1991: 575) and was noted often in the survey. An externality is a cost created by the activity of one agent but incurred by another. The objective of including environmental externalities in resource costing is to internalize this cost and ensure it is represented in the planning process. Thereby determining the true cost of the resource. In reality, the true cost can never be determined. Only an approximation is possible because the calculation of externalities is a difficult process at this time.

The range of impacts that can be considered by this method are non-site specific and include atmospheric visibility, human health risks, forests, crops, materials, and on land and water and air emissions of sulphur oxides, nitric oxides, and particulate matter (BPA 1992:5-51).

Externality values are calculated for those values where this is possible. These values are then either added to the cost of resources or are used to rate resources in the selection process (Pace 1991:564). Another method uses a "proxy percentage adder" on the costs of polluting resources or similarly a "percentage credit" for non-polluting resources (Pace 1991:564).

Depending upon the sophistication of this method significant resources can be required. The public is involved to the extent that they may be asked in surveys to give an economic value to a particular aspect of the environment.

Evaluation of EA approach

Whether there is sufficient information available to use this method depends upon the mix of resources that are being considered in the resource plan. As noted earlier many utilities use this system, but its application is not very appropriate for site-specific resources since "generic" resource externality costs are used (BPA 1992:5-51). Hydro-electric facilities are especially site specific and are also the likely resource that Manitoba Hydro will develop in the future.

This approach would enhance the consideration of non site-specific resources at a very early stage in the planning process. This approach would be an enhancement to existing planning since Manitoba Hydro does include mitigation cost estimates in the costing of generation facilities; therefore some environmental externalities are already internalized. However, unless methods are developed for costing site-specific resources at the same level of development as non-site specific resources it would seem unlikely that this method would be of much use for evaluating one resource against another.

The use of environmental externalities in resource costing would add another dimension to the present selection process rather than creating a new one therefore the resources required would be limited.

Conclusion

This EA approach meets all the criteria for only some power resources, therefore it is conditionally feasible.

EA approach 2: EA of power resource options.

Description of EA approach

An EA of power resource options is another method that is used to take into account externalities; primarily without using economics measures. This EA approach incorporates all impacts: this includes physical, biological, as well as socioeconomic. It is similar to the BPA draft environmental impact statement of its resource programs and the Netherlands Waste Management Council's EA of its *Draft Ten-Year Programme on Waste Management* 1992-2002 (TPWM) as outlined and characterized in Appendix D.

Each of these EAs share features that would be an important part of an EA of power resources. It would be an EA employed for long-term planning of power resources (20 - 25 years). Both of these EAs assisted in long-range planning efforts. The BPA document evaluated the environmental impacts of generic power resources, both the tradeoffs between resources and their cumulative impacts on the utility's system. The TPWM considered alternative waste management plans.

The EA would be developed from a predicted load scenario and a pessimistic load scenario to indicate the sensitivity of impact predictions to alternate futures. It is foreseeable that other scenarios would also be included (eg., best or worst case). The BPA EA assumed a worst case load forecast to emphasize environmental impacts. The TPWM EA had a similar worst case scenario for solid waste generation but also included a predicted scenario. The consideration of several alternative scenarios could prove valuable in determining the effect on power resource sequences should the public response to DSM programs be poorly estimated.

Numerous alternatives would be used to make sure that there is no early foreclosure of planning options. The TPWM included three waste management alternatives while the BPA EA considered thirteen alternatives that varied in terms of the costs included (ie. inclusion of quantifiable environmental costs), satisfaction of demand, and resource sequences. These resource sequences are composed of new resources that varied from reliance on no new resources to emphasis placed on different types of power resources.

The EA would use generic impact estimates that were readily available as done by the TPWM, BPA, and other EAs (Appendix D). The EA should consider primarily environmental changes and in those cases where information and resources are available direct and indirect impacts. The range of impacts that are considered by the

BPA EA are fairly diverse and include those from resource use or emissions from generation, as well as social and economic effects (including selected environmental externalities) and cumulative impacts. These impacts include environmental changes (e.g., Carbon Dioxide release) as well as direct impacts (e.g., Ozone emissions and resultant reductions in agricultural crop yields). The TPWM avoids consideration of direct impacts, instead aggregate environmental changes are predicted for certain components of the environment (e.g., Carbon Dioxide Emissions).

Evaluation of EA approach

Sufficient information would be available to conduct this type of EA. A qualitative site-specific evaluation of hydro-electric facilities is already considered in the next stage of the planning process. Moving this evaluation forward would be a significant change since a whole range of power resources would need to be evaluated earlier. While producing a more quantitative document may prove difficult in regard to hydro-electric facilities, this may prove unnecessary since the presentation of impacts may revert to a more qualitative form at the end of the EA. The BPA EA used a form of presentation that indicated relative levels of impact in relation to the present state of the system. This allows the use of the qualitative and quantitative impact information in the same format for the comparison of alternatives. Certain hydroelectric impacts can be presented in a quantitative form, these include area flooded, land-use for transmission lines, resource cost, numbers employed during construction, and population impacted.

The need for such an EA exists. Although this EA approach would add another level of analysis it would provide environmental analysis early in the planning process where it would have the most effect. With it, Manitoba Hydro would be able to perform its power resource planning with added confidence if a general guide for long-term resource planning had been predetermined outside of the power resource plan. Although the power resource plan does look forward twenty years it also considers the resource additions for the next couple of years. There is a certain amount of inherent circularity in allowing a power resource plan to be the basis for long-term planning. It may be better to allow another plan to provide the general guidance for the direction of the power resource plan.

This EA would require a significant level of resources, since it is a new level of analysis a large number of resources would need to be assessed. There are two ways that the resources required may be limited: firstly, generic information could be used to perform a part of the analysis. Unfortunately, as long as Manitoba Hydro's power resource options are largely hydro-electric there would be limited savings from the use of generic impact estimates here. Secondly, it may only be necessary to update the plan once every 2 or 3 years depending upon load growth or technological developments. This reduces the total time required to do such an EA. So although it may require more significant resources over a shorter period of time, this requirement would be averaged out to a smaller effort on a yearly basis.

Conclusion

This EA approach is unfeasible because it requires significant resources to be applied; however, this approach does warrant further study.

6.4.2 Decision Event 3

3. Final selection of power resource sequence.

Possible EA approaches:

- EA approach 3: Quantified analysis of all power resource sequences.
- EA approach 4: Quantified analysis of some power resource sequences.
- EA Approach 5: EA of selective issues.

EA approach 3: Quantified analysis of all power resource sequences.

EA approach 4: Quantified analysis of some power resource sequences.

Description of EA approaches

These approaches vary only in the degree to which they quantitatively predict impacts. Quantified analysis of power resource sequences would alter the present approach of qualitatively assessing the impacts of power resources. This change to the analysis could take a range of forms. The least significant change would be to consider certain impacts in a quantified way while still considering others qualitatively (EA approach 4). This is similar to a previous approach that is situated earlier in the decision making process (EA approach 2: EA of power resource options). Such an analysis could use generic values to measure environmental changes and impacts, with those related to the more site-specific resources such as hydro-electric generation being expressed both qualitatively and quantitatively. The other approach (EA approach 3) is a progression from the first since all impacts are considered quantitatively, also using generic values. Again, this may not be possible with all impacts of certain resources, especially those that are very site specific and often related to hydro-electric facilities.

The analysis of avoided supply-side impacts by Ontario Hydro is an example of a limited quantified EA that contributes to an overall environmental analysis (Appendix D). This EA considered two alternatives: a resource sequence including DSM and one without DSM. The environmental changes due to the DSM program were found by subtracting the overall effects of the DSM alternative from the no DSM alternative. This EA considered a limited number of environmental components that were selected on the basis of their ability to be quantitatively estimated. Another limitation was the lack of consideration given to direct DSM impacts, possibly a result of their limited extent, seriousness as well as limited budgetary resources. Regardless, this EA performs an adequate task of indicating the environmental benefits of all DSM programs related to other resource alternatives.

Evaluation of EA approaches

Quantified analysis of power resource sequences is confronted by the same problems that are faced by the earlier EAs on power resource options (EA Approach 1 and 2): many of these are site specific impacts that in the cases of hydroelectric facilities cannot always be determined in a meaningful way until a full EA is done. Therefore an EA of all power resource sequences could not be accomplished. However, for some resources sufficient information would exist for environmental impacts to be quantitatively determined, allowing EA approach 4 to be used.

There is a need for an approach that could allow for more precise tradeoffs to be made between resource sequences. In many cases this may not be possible, but the inclusion of more quantitative descriptions of environmental impacts will improve the process in certain cases. This would be most likely when tradeoffs are made between resources with non site-specific impacts (e.g., Thermal resources, DSM). In the case of Manitoba Hydro this would vary depending upon the resource sequences being considered within that particular power resource planning exercise. This suggests that depending upon the resources being considered the character of the EA in the power resource plan could change to suit the resources.

EA approach 4 would not require significant budgetary or staff resources since it does not involve a new EA approach, only the alteration of an existing one.

Conclusion

This EA approach is only conditionally feasible because there is often insufficient information for its use.

EA Approach 5: EA of selective issues.

Description of EA approach

A different type of EA is the EA of selective issues. This EA approach has a relatively flexible scope of application. Its objectives would vary with the assessment needs; although not as comprehensive an EA as those performed on complete programs or projects, it would provide a thorough examination of a limited range of issues or impacts. An issue could be either very broad such as future environmental management and regulatory practices related to all power resource options, or it could be an extremely narrow issue such as investigating mitigation methods for a ground source heat pump DSM program. This type of EA could use either quantitative or qualitative methods depending on the issue and the information available.

Identification of further EA needs is an aspect of the planning process that should be included from the beginning and probably throughout the process. This would be one mechanism that could trigger an EA of selective issues. For example, the qualitative EA already used in the development of the power resource plan could trigger an EA regarding identified issues or concerns related to a possible DSM program. Other triggers could include a new type of early EA, a full supply resource EA, or merely the foresight of power resource planners. This EA approach could integrate into the existing planning process by becoming either an individual EA or part of a tiered (multi-staged) EA process.

Evaluation of EA approach

This EA approach would be selectively applied and in that case it would only be used when sufficient information existed.

The need for this EA is significant since certain issues and individual DSM programs are not at present receiving an EA of any type. These issues may appear at any of the decision events including the period after the power resource plan is implemented. As noted above it need not be used unless it is felt that one is required.

Again this EA approach would be selectively applied, and as such it would only be used when planners felt that its use would justify the resources required.

Conclusion

This approach is feasible since sufficient need exists and it can be performed with available information and limited resources.

6.4.3 Decision Event 4

4. DSM program plan completed.

Possible EA approaches:

- EA Approach 6: Complete EA of all DSM programs.
- EA Approach 5: EA of selective issues.

EA Approach 6: Complete EA of all DSM programs.

Description of EA approach

A complete EA of DSM program alternatives would enable tradeoffs to be made between DSM programs with greater or fewer environmental impacts. This EA could consider the environmental changes and or direct impacts of DSM programs or take the form of the EA performed by Ontario Hydro on the avoided supply-side impacts of its DSM programs, as mentioned earlier. It could be expanded to assess both the direct and indirect impacts of all DSM programs. These EAs could also use qualitative or quantitative forms of analysis. However, the quantitative analysis would be better at helping to make tradeoffs between programs than would a strictly qualitative analysis.

As with Ontario Hydro's analysis of avoided supply-side DSM impacts, the use of generic information on environmental changes would greatly simplify the resources required to perform an analysis of this type if information is available. In terms of DSM programs generic information on environmental changes as a result of indirect impacts is necessary because a full EA of supply side projects is not available at this stage of the planning process. In addition, the widespread nature of many of the direct program impacts also dictates that generic information be used. The real question is whether this information is available. A few large EAs have been done that go beyond consideration of only environmental changes; the BPA New Energy Efficiency Home Program EA is an example of this type of EA although it focuses on only one program (Appendix D). This EA develops interior air contaminant models as well as health impact models that predict the potential of home energy efficiency programs at causing deaths due to lung cancer and other diseases.

Evaluation of EA approach

There is sufficient information available for a qualitative EA, and likely enough for a quantitative one also. The only deficiency would lie with the need for quantitative determinations of the avoided supply-side impacts from hydro-electric facilities. This is a significant limitation to quantitative assessment since Manitoba Hydro will largely rely on hydro-electric resources for future supply expansion.

The need for this analysis is not significant, there are few serious direct impacts from DSM programs. The few DSM programs with direct impacts of concern would benefit by receiving individual attention, without placing all DSM programs under scrutiny. The avoided supply-side impacts are for the most part positive since reductions in the use of supply resources occurs. Depending upon the type of supply resources these positive impacts can vary. There is one exception to the lack of need for this type of EA, the survey noted a need for an EA to justify a specific level of DSM. However, the need for justifying the overall levels of DSM programs would more likely be found at an earlier stage in the power resource and DSM planning process.

Conclusion

This EA approach is not feasible since there is not sufficient need for it at this time.

EA Approach 5: ***EA of selective issues.***

Description of EA approach

The issue EA discussed earlier could be performed at this stage also, either after being triggered in this stage or a previous one.

Evaluation of EA approach

The evaluation for decision event three has already discussed and evaluated this EA approach and none of the arguments have changed. The greater availability of information only improves the feasibility of this approach.

Conclusion

This is a feasible EA approach for application to selective issues or impacts of DSM programs.

6.4.4 Decision Event 5

5. Finalization of individual demand/supply resource plans.

Possible EA Approaches:

- EA Approach 7: Full EA of DSM programs
- EA Approach 5: EA of selective issues.

EA Approach 7: Full EA of DSM programs

Description of EA Approach

A full EA of a DSM program could consider either the direct, indirect or all impacts related to that program. The full EA could do a detailed evaluation of various mitigation measures that could be used to reduce specific program impacts. The BPA energy efficiency home program EA is an example of a full EA done on a DSM program (Appendix D). This EA's objective was to assess the ability of different techniques in managing indoor air quality in energy efficient homes (e.g.,'s: Mechanical Ventilation, No Ventilation). These different techniques were the alternatives within this EA. In effect this EA went beyond merely assessing the impact of a program and suggesting mitigation, the objective is the determination of the impacts of a program while employing different mitigation strategies. Since a DSM program would have already been scrutinized for unmitigatable impacts this is the type of EA a DSM program would have at this stage in the planning process.

The types of impacts assessed by this type of EA would vary depending upon the program and the impacts and changes that had been identified, likely at an earlier EA stage. The BPA EA considered a range of changes and impacts including direct and indirect impacts on biophysical, socioeconomic, and health environmental components.

Evaluation of EA approach

For most programs sufficient information would be available to perform an analysis using generic information. The exception would be the many avoided supply-side impacts of hydro-electric resources.

There is not a significant need for this EA approach because most DSM programs do not have significant impacts. There is one exception - the health impacts of DSM programs that increase the energy efficiency of homes. BPA has performed EAs on its energy-efficient homes program and energy-efficient commercial buildings programs, programs that influenced interior air quality of buildings and possibly the health of occupants. The infrequency with which this EA would be used and the limited nature of impacts suggests that programs of concern could be assessed by an EA of selective issues.

Conclusion

There is insufficient need for a full EA of DSM programs.

EA Approach 5: *EA of selective issues.*

Description of EA approach

Again, at this stage issue EAs could be performed if it was considered to be necessary. Issue EAs at this stage may be used as a response to the appearance of unexpected impacts that occurred once program implementation had begun.

Evaluation of EA approach

The evaluation for decision event three has already discussed this EA approach. Although more information is available, none of the earlier arguments regarding this approach have changed.

Conclusion

This approach is feasible for application when the individual DSM program plan(s) are completed.

6.5 CONCLUSIONS

The EA of selective issues fully met the pre-determined criteria while the Quantified EA of some power resource sequences and the Integration of environmental costing conditionally met the criteria (Table 4).

The Quantified EA of some power resource sequences may be feasible for evaluating the non site-specific impacts of some resources (e.g., DSM, thermal power plants, gas turbines) in regard to regulatory compliance or environmental costing. However, the more general Integration of environmental costing would have limited feasibility until the costing of site-specific and non site-specific impacts of resources reach the same level of maturity. Until then comparisons using environmental costs can be done within, but not between these two types of resources. A third approach, the EA of power resource options failed to meet the criteria because of the significant resources that it would require. Should Manitoba Hydro decide that this EA would be worth the investment of resources it would be a useful addition to the earliest stages of the planning process.

Although one approach is feasible, and two conditionally feasible, the advanced nature of DSM planning suggests that the selective issue EA approach would be the most appropriate type of analysis for addition to the planning process. This approach merits further development.

	Decision event	Environmental analysis	Issues and Limitations	EA Approaches	*Evaluation Criteria* Info. Available	Need	Limited resources	Feasibility
1	Selection of initial resource option set.	None	No early consideration of environmental issues.	(1) Integration of environmental costing.	<u>Yes</u>, for non site-specific resources.	Yes	Yes	Conditional - in some cases.
				(2) EA of power resource options.	Yes	Yes	No	No
2	Screening of resource option set.	None						
3	Final selection of power resource sequence.	Initial qualitative environmental evaluation.	• Quantitative analysis may be useful in certain circumstances.	(3) Quantified EA of all power resource sequences.	No			No
			• Lack of more detailed analysis of impact issues raised by initial env. analysis.	(4) Quantified EA of some power resource sequences.	<u>Yes</u>, for non site-specific resources.	Yes	Yes	Conditional - in some cases.
				(5) EA of selective issues.	Yes	Yes	Yes	Yes
4	DSM program plan completed.	None	• Lack of analysis of complete DSM program plan.	(6) Complete EA of all DSM programs.	Yes	No		No
				(5) EA of selective issues.	Yes	Yes	Yes	Yes
5	Finalization of individual demand/ supply plans.	• DSM - None	• Lack of analysis of DSM mitigation options and regulatory concerns.	(7) Full EA of individual DSM programs.	Yes	No		No
		• Qualitative/Quant. EA of Next Power Resource Addition.		(5) EA of selective issues.	Yes	Yes	Yes	Yes

Table 4 **<u>Evaluation of EA Approaches</u>**

CHAPTER 7
APPLICATION OF ISSUE ORIENTED APPROACH TO DSM PROGRAMS

7.1 INTRODUCTION

The previous chapter presented a variety of EA approaches that were intended to address some of the shortcomings identified in the environmental analysis within Manitoba Hydro's planning process. These approaches were evaluated and the EA of selective issues was chosen as the most promising for application to DSM programs. This chapter develops this approach further by applying it to DSM programs.

7.2 EA PROCESS FOR DSM PROGRAMS

The environmental impacts from DSM programs were outlined earlier in this study. These impacts were a result in most cases of either direct or indirect release of various contaminants into the environment. As noted earlier (Section 3.2.1.2) the consideration of these emissions can follow an evaluation of environmental changes as a proxy for impacts, or it can be widened to include environmental impacts. The choice between these two methods is related to the resources available for the EA and the information required. The survey data and the examples of DSM EAs suggest that DSM program EAs could have several objectives:

1. Identify/predict/evaluate environmental changes or impacts.
2. Evaluate alternative mitigation methods.
3. Determine if a full EA is necessary.
4. Determine regulation or liability trends/issues.

While an EA could deal exclusively with one or several of these objectives, it is most likely that all four would be addressed to a varying extent; some of these objectives are related and represent only progressions from other objectives. For example, the third objective (determine if a full EA should be done) would likely always be included with the first objective (identify/predict/evaluate impacts) when doing less than a full EA as a trigger mechanism for further or more detailed study.

In order to create a detailed EA framework for a DSM program, a few assumptions and observations are required. The most likely EA of an individual DSM program would have two main objectives, evaluating specific environmental changes or impacts and determining if mitigation is necessary. This type of EA would follow an earlier and likely more general EA (e.g., Qualitative Environmental Evaluation in the Power Resource Plan). The environmental changes/impacts would have already been identified in most cases and as such the EA need not include a formal identification process. The EA would be focussed and multi-staged, it would not attempt to do a wide-ranging EA but instead would start out with a small number of objectives. It would have an adaptable structure, with extra stages that would allow it to consider issues in more detail should it prove necessary. This internally tiered structure should make the EA responsive to the demands of different programs and issues while at the same time sparing resources by avoiding unecessary work. A generic EA outline has been adapted from the general EA framework described in chapter three.

Generic EA outline :

1. Scoping - determine study boundaries.
2. Description of alternatives
3. Impact identification
4. Impact prediction - baseline prediction of impacts/effects
   program impacts/effects
5. Significance assessment
6. Evaluation of alternatives
7. Mitigation
8. Monitoring

7.3 OVERVIEW OF DSM EA

The tiering (or staging) of a DSM EA would follow a pattern where only those parts of an EA that were necessary to accomplish the objectives are performed. This would be a multi-stage EA. If one stage of the EA is performed it will not have to be repeated unless drastic changes have occurred to the data used in the stage(s) performed, or new impacts or alternatives require consideration.

The DSM EA would have two stages, each with different objectives (Figure 6). The first stage would evaluate direct impacts

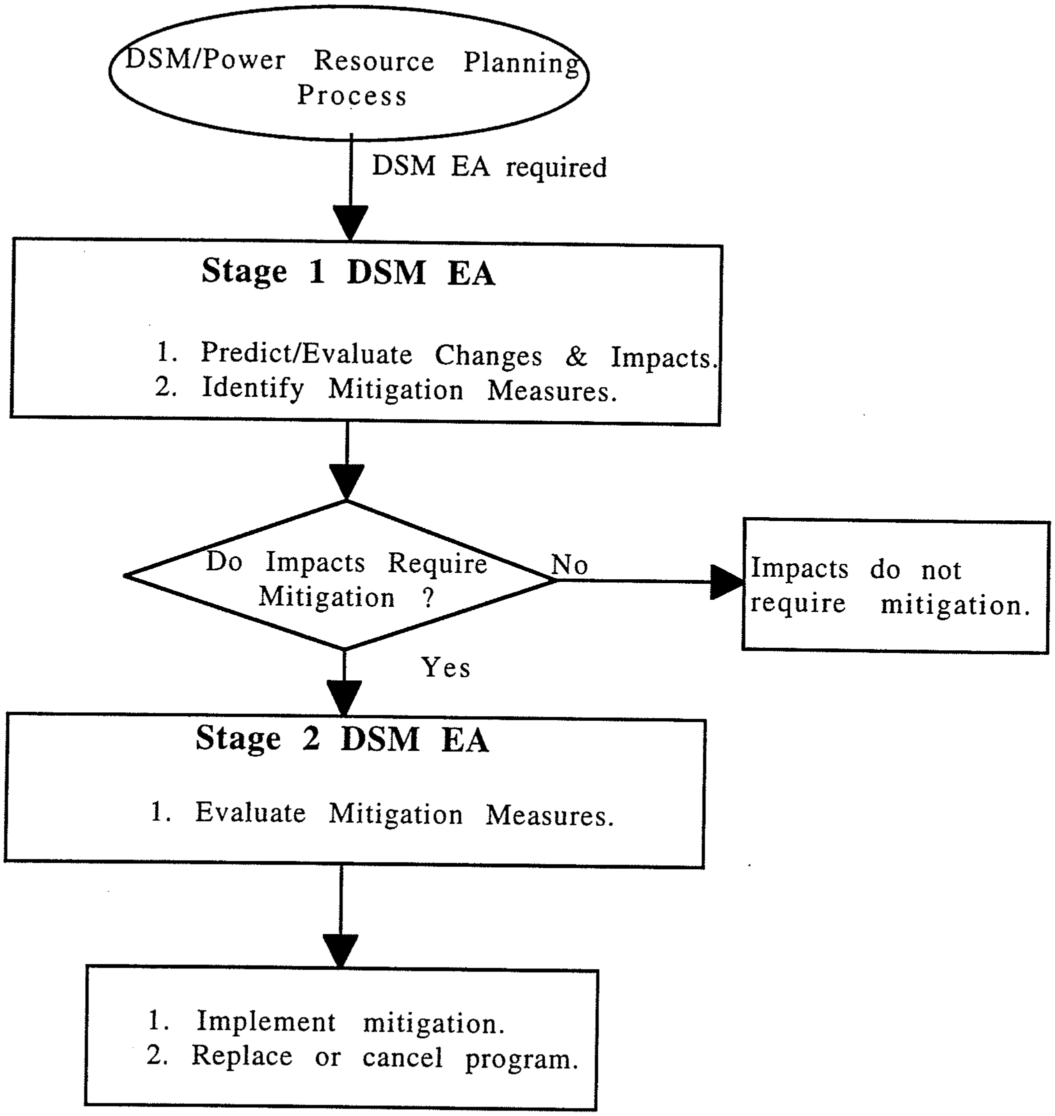
DSM/Power Resource Planning Process
DSM EA required
Stage 1 DSM EA
1. Predict/Evaluate Changes & Impacts.
2. Identify Mitigation Measures.
Do Impacts Require Mitigation ?
No
Impacts do not require mitigation.
Yes
Stage 2 DSM EA
1. Evaluate Mitigation Measures.
1. Implement mitigation.
2. Replace or cancel program.

Fig. 6 DSM EA

identified as being potentially significant by the previous EA or another part of the planning process. The second stage would evaluate mitigation measures.

Avoided supply-side impacts would be unassessed in this EA. There are several reasons why their inclusion would not contribute to the decision making process. Avoided supply-side impacts are better considered in the early stages of the planning process, before the fourth decision event (DSM Program Plan Completed), when tradeoffs can be made between DSM programs or supply resources.

These impacts are generally positive and therefore not important to the evaluation of mitigation alternatives. Should a program be changed to mitigate impacts the avoided supply-side impacts would remain unchanged. Assuming demand is equally reduced by the altered DSM program.[1] If a DSM program is cancelled because of negative impacts that are too difficult or costly to mitigate the likely result is that the program will be replaced by another DSM program or an existing program would be intensified to maintain the same level of DSM; again avoided supply-side impacts would remain largely unchanged.

An EA of a load shifting program would be an exception since these programs do not result in a demand reduction and the related positive environmental impacts. In this case the avoided supply-side impacts would be considered along with other impacts, in fact they would probably receive the greatest attention. It is more likely that

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1 A situation may arise where the supply-side impacts are either increased or decreased when a demand reduction is of a similar magnitude but at a different time or date. This is due to the fact that displaced power resources and their attendant impacts may vary daily, weekly, and monthly.

if avoided supply-side impacts are considered it will be in a broad sense covering the whole range of DSM programs at an earlier stage in the planning process when other resources are being considered.

The scope of the direct impacts or effects considered by the EA would vary between the program being considered and its related impacts (Table 1). Usually, specific program impacts or effects of concern would be identified by an earlier EA or the planning process. Often, these concerns could be reduced to only one or two primary impacts or effects of concern due to the limited number and significance of effects that DSM programs produce. As mentioned earlier (Section 2.4.2) the nature of the program impacts that have been identified suggests that it would be difficult in many cases to predict and evaluate impacts because of the large numbers of sites (program participants). The use of environmental changes as a proxy for environmental impacts would be the likely means of attempting to better understand the seriousness of these impacts in relation to other activities as well as regulations and standards. In some cases it may be possible to identify health impacts if they are related to a specific action of the program (e.g., increased cancer risk due to decreased ventilation rates in energy efficient homes). It may also be desirable to identify sensitive environmental components or regions that may exist in relation to the identified potential environmental changes/impacts (e.g., identify areas with sensitive aquifers).

7.3.1 FIRST STAGE OF DSM EA

In determining the environmental changes from a DSM program it would not be necessary initially to go beyond the evaluation of environmental changes and the identification of mitigation alternatives in relation to specific direct impacts. The first stage of the EA would only consider one alternative, the no program alternative, since there are no other alternatives at this point. An optional part of this stage would be the use of alternative scenarios for making program impact predictions to determine the effect of a pessimistic, optimistic, or other levels of program performance. This stage of the EA would determine whether mitigation was necessary.

Outline of first stage DSM EA

Scoping

1. Constraints on study.

a.) Temporal

- Likely the length of the program.

b.) Spatial

- Likely the service area of the utility.

c.) Range of changes/impacts.

- Impacts or effects that are of concern.

Impact Identification

1. Environmental changes/impacts determined by earlier EAs.
2. Identify sensitive environmental components.

Impact Prediction

1. Baseline Environmental Changes/Impacts Without the Program.
   a.) Similar sources or activities.
   b.) Other sources or activities.

2. Program Changes/Impacts
   a.) Direct changes/impacts.
   b.) Identify indirect changes/impacts.

Significance Assessment

1. Define regulatory levels related to changes/impacts.
2. Define ambient levels related to changes/impacts.
3. Sensitivity of Environmental Components.
4. Characterization of environmental changes/impacts.
   4.1 Impact duration
   4.2 Impact relative magnitude.
   4.3 Impact risk
5. With and without program comparison.
6. Cumulative environmental changes/impacts.
   6.1 Similar activities in region with and without program.
   6.2 Similar environmental changes/impacts from other sources or activities.

Evaluation of Alternatives

1. Comparative analysis of significant changes/impacts of program alternatives (Program, No Program, Mitigation Alternatives).

Mitigation

1. Identify available mitigation methods and examples.

Public Involvement

1. The use of a survey to discern what (if any) public concerns exist about the environmental changes/impacts of the program.

Monitoring

1. Monitoring may be required to determine the significance of program changes/impacts or to determine if the next EA stage is necessary.

7.3.2 SECOND STAGE OF DSM EA

The objective of the second stage EA would be the detailed evaluation of mitigation alternatives. These alternatives would include the No Program and Program alternatives considered in the first stage as well as other mitigation alternatives. The evaluation of these alternatives would include consideration of changes and impacts on environmental components as well as the cost-effectiveness of the program when mitigation costs are included as part of the total resource costing for the program. Several aspects of the first stage of the EA or other earlier EA would not be repeated in this stage (e.g., scoping, impact identification, parts of the significance assessment, impact prediction - baseline assessment).

Outline of second stage DSM EA

Scoping

1. Constraints on study.
   - Determined in first stage.

Impact Identification

1. Environmental changes/impacts determined by earlier EAs.
2. Identify any changes/impacts due to mitigation methods.
3. Sensitive environmental components identified in first stage.

Impact Prediction

1. Baseline Environmental Changes/Impacts without the program.
   - Determined by earlier stage.
2. Program and Mitigation Alternatives Changes/Impacts.
   a.) Direct changes/impacts.
   b.) Identify indirect changes/impacts.

Significance Assessment of Mitigation Alternatives

1. Define regulatory levels related to changes/impacts.
2. Define ambient levels related to changes/impacts.
3. Sensitivity of Environmental Components.
4. Characterization of environmental changes/impacts.
   4.1 Impact duration
   4.2 Impact relative magnitude.
   4.3 Impact risk
5. With and without program comparison.

6. Cumulative environmental changes/impacts.

    6.1 Similar activities in region with and without program.

    6.2 Similar environmental changes/impacts from other sources or activities.

Evaluation of Alternatives

1. Comparative analysis of significant changes/impacts of alternatives (Program, No program, and Mitigation Alternatives).

2. Reevaluation of program cost-effectiveness by including any mitigation costs in the total resource cost for the program.

Public Involvement

1. Public involvement through consultations with interest groups and several public meetings would be necessary to build a consensus as well as involvement in the mitigation efforts.

Monitoring

1. If a mitigation alternative is implemented the effectiveness of these measures need to be determined at regular intervals.

7.4 TRIAL DSM EA (STAGE 1) OF ENERGY EFFICIENT LIGHTING PROGRAM

The Selective DSM EA framework was given a trial application on the Energy Efficient Lighting Program of Manitoba Hydro (Appendix G). This trial made several assumptions regarding the success of the program that raise the uncertainty of any conclusions.

However, even allowing for this uncertainty the conclusions are unlikely to change. This approach had several strengths and weaknesses, these were identified below along with some solutions that address these weaknesses.

In general the approach of estimating impacts from environmental changes was effective at determining the relative impact of the environmental changes from other sources. One problem that arose is that direct comparisons are difficult when the environmental change (in this case a contaminant release) from a comparison source is released into a different medium and with a different spatial distribution. This can be seen in the direct comparison of widely dispersed mercury from lamps as solid waste that accumulates in landfills as opposed to the point release of mercury from a smelter as an air contaminant. In the EA the consideration of mercury from other sources was divided between natural sources, anthropogenic sources and municipal solid waste. This last category eliminates many of the point sources that did not release their contaminants in the same area as the lamps by concentrating on a specific waste stream.

The above limitations do not make this approach less useful, it merely suggests that proper caution be used when interpreting any results. In many circumstances this approach provides an understanding of the relative seriousness of contaminant release.

There are two approaches to a more definitive determination of impacts. The first is determining the impact thresholds of environmental components in these areas, the second is the distribution of contaminants. The first is considerably more involved than the second. One approach that would lessen resource requirements, although providing less information, is to determine the distribution of contaminants first. The impact in these cases depends upon the sensitivity of the landfill as well as the dispersion of the waste between landfills. This method would enable the identification of problem areas prior to the investment of resources on determining impact thresholds.

Since many of the impacts related to DSM programs concern the release of contaminants it is sometimes unnecessary to consider the impacts upon environmental components when regulations exist for these same impacts in similar circumstances. This is especially the case in relation to human health and safety impacts. In these cases the determination of regulatory compliance can be more important than producing a precise prediction of impacts since regulatory levels have been determined to reduce or eliminate such impacts. Thus where regulations related to identified impacts exist it may be wise to limit any further resources aimed at evaluating those impacts.

As mentioned in the EA an effective way of increasing the reliability of the projections would be to evaluate alternatives using several scenarios related to program success, baseline prediction, as well as other variables. This form of sensitivity analysis would help determine the range of possible futures that could be expected, and would highlight areas for future inquiry.

While performing the EA it became clear that the identification of impacts required a more detailed approach than only describing the impacts found by previous studies. This involved a description of the impact process and the effects. In the case of this EA it involved a description of the biological and health effects as well as the pathways of mercury within the environment after release during lamp disposal.

Overall there were few difficulties in finding the information to produce the EA. Ample information was available on the past sales of lamps as well as the content of these wastes found in U.S. solid waste to allow for the calculation of Manitoba lamp sales and Manitoba solid waste distribution. Although information was available on other mercury sources in the province, this information was dated in some cases. In several areas were variable output was expected (industrial point source pollutants) more recent information was not obtained. In these cases the information was not released by the emitting establishment nor was this information available from the provincial environment department. Other problems with predicting impacts involved the difficulty in determining data on natural sources that were specific to the province rather than global estimates.

The discussion of the regulatory levels within the trial went beyond those applicable to Manitoba. This had the benefit of indicating the possibilities of future changes in regulatory levels that would alter the need for mitigation measures.

Cumulative environmental changes were determined for similar and other sources or activities in the region. Although this looked at additive environmental changes it failed to consider these over time. In order to consider the time element in cumulative changes it is necessary to determine the contaminant pathway over time (in this case the mercury flux in the environment). This has been accomplished for some areas of Sweden regarding mercury contamination.

The identification of mitigation methods and examples of mitigation efforts effectively presents a range of options for future inquiry. The preliminary discussion of mitigation costs is a good extension to this discussion. This section could be enhanced by the inclusion of some indication of what methods where most appropriate for application in this province or with the specific DSM program receiving mitigation. There should also be an indication as to why these methods were considered appropriate.

7.5 CONCLUSIONS

The EA of selective issues was further developed into a framework for the assessment of DSM programs. The objectives of this EA included evaluating the direct impacts or environmental changes of the program, and identifying possible mitigation measures; these objectives have been largely met and in a few cases surpassed. Two additional features of this framework were an overview of the present and future state of regulations regarding the release of contaminants, and the extension of the identification of mitigation measures to a discussion of mitigation examples, their costs, and to some degree their problems and possibilities for application in the province. Both of these features give Manitoba Hydro a better idea of what mitigation measures entail so that they can decide if the complete evaluation of mitigation measures, provided by the second stage of the EA, would be useful.

A number of limitations and other benefits of this approach were noted in the EA and in the comments of the previous section. These limitations made the EA more difficult to perform however, none prevented the achievement of the two main objectives. This suggests that the Selective DSM EA is the optimal EA framework for DSM programs.

CHAPTER 8
CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

Demand side management programs are new and there is little experience in assessing their environmental impacts. EA practitioners have accumulated considerable experience in the performance of environmental impact assessments on projects, but this is not the case for programs such as DSM. At present Manitoba Hydro performs a limited environmental assessment of its DSM programs, approximately midway through their power resource planning process.

In order to determine the need for a more thoughtful environmental assessment of DSM programs, several specific objectives were formulated and became areas for research. These areas included determination of the characteristics of the potential environmental impacts of DSM programs, the legislative requirements for the EA of DSM programs, and the EA practices of Manitoba Hydro and other utilities in relation to DSM programs.

8.1.1 ENVIRONMENTAL IMPACTS OF DSM PROGRAMS

Evaluation of DSM activities, their potential environmental impacts, and the mitigation of those impacts, lead to several conclusions about the characteristics of the impacts associated with

DSM programs, their possible influence on DSM programs, and their overall significance.

1. DSM program impacts can be divided into direct, indirect, and avoided supply-side impacts. The direct and indirect impacts are usually related to the emission of contaminants from DSM equipment leading to a small number of spatially diverse impacts of usually limited individual significance. The avoided supply-side impacts vary by utility since they are related to the equipment used to generate electricity. They are often large in number, usually spatially concentrated and can often become significant (Chapter 2).

2. Many of the direct impacts from DSM programs can be characterized as situation-specific rather than site-specific in terms of impact significance. The direct impacts of DSM programs are usually related to the emission of contaminant substances and their significance is determined by the situation of the release. Examples of situations that influence the nature of impacts include, the improper training of lighting or refrigeration repair persons, or the absence of local recycling programs (Chapter 2).

3. DSM programs rely on the use of market mechanisms to promote reduced energy use. The presence of real or perceived hazards, regulations, or mitigation to limit any hazards can create

a program feedback effect that can impede the success of a program and limit any positive impacts (Chapter 2).

4. Although there is a mixture of positive and negative impacts resulting from DSM programs, from an overall electricity management context a net-positive impact usually results. Although impacts do exist, these are typically small and outweighed by the reduction in impacts resulting from being able to avoid or defer development of new generation capacity. Few of the impacts resulting from DSM programs cannot be mitigated (Chapter 2).

8.1.2 LEGISLATIVE REQUIREMENT FOR THE EA OF DSM PROGRAMS

The application of EAs to projects is usually guided by requirements derived from environmental legislation. The submission of EA statements is often a necessary part of a project approval process. Determining the requirements for programs was the focus of an inquiry into legislation both in Canada and elsewhere (Section 3.2).

1. There is presently no legislative requirement for the EA of DSM programs in Manitoba.

2. Although DSM programs are required by the province of Ontario to be indirectly assessed for environmental impact as part of the Ontario Hydro power resource plan, this is the sole case in Canada.

3. A number of provinces are considering greater requirements for the EA of programs as well as projects, however these requirements may not be part of the traditional EA process. Instead, the power resource plans of utilities and their DSM programs may receive a type of EA outside of the traditional EA process.

8.1.3 DSM EA PRACTICES OF UTILITIES

Results of the survey of electrical utilities indicate that a wide variety of EA types are being used as well as suggested for possible use by a limited number of utilities (Chapter 4). However, four general types of EA can be identified from this research, including the following:

1. EAs used as a planning tool that compare, both qualitatively and quantitatively, demand and supply side resources in order to limit environmental impacts. This type of EA can be part of the integrated resource assessment that determines the environmental emissions of different power resource plans. Further, it can also be part of a national program to reduce the environmental impacts of all utilities.

2. EAs used as a mechanism for determining environmental externalities and using these to find the true cost and cost-effectiveness of DSM programs to the utility and society.

3. A program or issue-oriented EA where a program is studied in relation to any or all of its perceived environmental impacts. This type of assessment usually determines the seriousness of a problem, determines the relevant regulations or liability issues which apply, and finally considers possible mitigation measures. It may consider any or all of these issues related to that program.

4. Issue-oriented EAs that consider an issue related to all resources, both supply and demand. Examples have been given of assessments of trends in environmental regulations.

Many of these are not traditional types of EA, but they are being used to accomplish one of the main objectives of EA - determining environmental impacts and including them in the decision making process. Utilities also indicated, however, several constraints in application of EA to their DSM programs, including the following:

1. There is limited use of EA tiering (multiple stage EA) among utilities. Those utilities performing EAs of DSM programs do so mainly at the later stages of the planning process, specifically

during the development of the overall DSM program plan and individual DSM programs.

2. Few utilities perform product life cycle analysis, while none suggested that the manufacturer of the DSM products should be required to do so.

3. Utilities indicated that responsibility for implementation and funding of mitigation rested with the utility and to a lesser extent government and industry.

4. The degree of public involvement in EAs remained limited unless it was part of a public hearing process or to a lesser degree a survey of public opinion.

A relative comparison of Manitoba Hydro's EA process and the process used by other utilities allows the following conclusion to be made:

1. Manitoba Hydro is largely at the same level of development of DSM program EA as other utilities that also perform DSM program EAs, with all indicating some EA at a single stage. However, Manitoba Hydro performs DSM EAs during the development of the power resource plan which is earlier in the planning process than most EAs of other utilities.

8.1.4 NEED FOR A DSM EA

Beyond the individual conclusions in the areas of impact characteristics, legislative requirements and utility EA practice, a more general conclusion can be offered regarding the need for the EA of DSM programs.

1. At present Manitoba and other jurisdictions have no legislative requirement for the EA of DSM programs, but Manitoba Hydro and several utilities outside the province are undertaking EAs for a variety of reasons, all of these attempting to determine environmental impacts and include them in the decision making process at some level. Although the potential environmental impacts of DSM programs are limited, it is only prudent that they be assessed to minimize any negative impacts on the environment (including public health and safety) while maximizing any positive impacts.

8.1.5 MANITOBA HYDRO EA

Determining the scope of any environmental assessment of DSM programs required consideration of Manitoba Hydro's power resource and DSM planning process as well as the EA that is a part of that process. One result of the research into the power resource planning process was a realization of the size and hierarchical nature of the planning process. It was felt that determining the scope of an EA by considering only the DSM program development stage would result in an EA approach that was useful at that level, but that might be more appropriately applied at another place in the planning process. Avoiding this problem required that the evaluation of the scope of an EA go beyond considering the DSM program development stage to considering the wider power resource and DSM planning process.

The placement of EA in the planning process is an important determinant in its success as well as its usefulness. One way of finding the correct place is by considering the major decision events in the planning process and ensuring that environmental analysis is integrated into these events. In this way the appropriate level of analysis will occur before commitments have been made regarding power resource options or program alternatives.

Manitoba Hydro's power resource planning process was evaluated and five main decision events were identified (Section 5.2):

1. Selection of the initial resource option set;
2. The screening of the resource option set;
3. The final selection of the power resource sequence;
4. The completion of the DSM program plan;
5. The finalization of individual demand/supply resource plans.

The decision events that are embodied in a power resource planning process are preceded by particular environmental analysis needs. It is these needs and the degree to which they are met that determines whether any changes are required in the planning process.

The following conclusions resulted from the evaluation of the EA within the planning process used by Manitoba Hydro regarding what is present and what is missing from the EA portion of that process (Section 5.4):

1. Manitoba Hydro performs limited environmental costing of power resources during the selection of the initial resource option set (eg. Determining the mitigation or compensation costs of hydro-electric facilities).

2. Qualitative EA of all power resources occurs at the final selection of the power resource sequence.

3. Qualitative and some quantitative EA of supply options occurs during selection of the next supply resource to be developed. The selected supply resource receives further qualitative and quantitative EA prior to requesting an environmental license from the province.

4. There is a lack of consideration of environmental issues at the early stages of the planning process prior to the selection of the initial resource option set. A broad based environmental analysis of long-term power resource options would be useful at this stage to provide information to the option selection process.

5. Quantitative analysis may be useful in relation to DSM programs: 1) when regulatory concerns are present; or 2) environmental costing is being used in the economic analysis of resources.

6. During the final selection of the power resource sequence, there is no follow-up EA after the initial environmental evaluation. This prevents the further analysis of issues raised by the initial environmental evaluation.

7. There is no EA of the complete DSM program plan thus limiting possible adjustment of program type or intensity according to environmental impacts.

8. There is no analysis of DSM program mitigation options and regulatory concerns. Although impact concerns are not serious, they have been addressed to varying degrees in other jurisdictions. It would seem prudent that these issues also be considered by Manitoba Hydro.

9. The primary areas of the planning process most in need of EA are the earliest and the latest stages. Specifically, before the selection of the initial resource option set for all resources and after the final selection of the power resource sequence for DSM programs.

8.1.6 NEW EA APPROACH

A varied group of EA approaches were proposed to meet the limitations identified in the environmental analysis within the Manitoba Hydro power resource and DSM planning process. These EA approaches applied to a wider portion of the power resource and DSM planning process than the narrowly defined program development stage indicated in the objectives of Chapter 1. A set of criteria were created that assessed each proposed approach according to need, information available to use the approach, and the resources required to implement the approach.

The EA approach evaluation indicated that the EA of selective issues fully met the pre-determined criteria while the Quantified EA of some power resource sequences and the Integration of environmental costing conditionally met the criteria. The Quantified EA of some power resource sequences may be useful when evaluating the non site-specific impacts of some resources (e.g., DSM, thermal power plants, gas turbines) in regard to regulatory compliance or environmental costing. However, the more general Integration of environmental costing would have limited use until the costing of site-specific and non site-specific impacts of resources reach the same level of maturity. Until then, comparisons using environmental costs can be done within, but not between these two types of resources. A third approach, the EA of power resource options failed to meet the criteria because of the significant resources that it would require. Should Manitoba Hydro decide that this EA would be worth the investment of resources it would be a useful addition to the earliest stages of the planning process.

The EA of selective issues was further developed into an EA framework by choosing the most appropriate EA components for achieving the objectives of a DSM EA. This framework can be included in the power resource and DSM planning process after the final selection of the power resource sequence when the DSM program plan and individual DSM program plans are completed.

8.1.7 DSM EA FRAMEWORK

One of the final objectives of this research was the trial of the developed EA framework. A trial of the framework was performed on Manitoba Hydro's Energy Efficient Lighting Program. In this trial, the objectives of the EA included evaluating the direct impacts or environmental changes of the program and identifying possible mitigation measures. Despite several limitations (Chapter 7.3) the objectives have been largely met and in a few cases surpassed. In this regard the following conclusion is reached.

1. The Selective DSM EA appears to be the optimal EA framework for meeting the needs of DSM program planning after the selection of the power resource sequence. It provides a focussed two-staged EA for identified issues of concern related to DSM programs. These concerns could be identified with the selection of the power resource sequence or later in the planning

process. The first stage evaluates impacts in order to determine their significance and identifies potential mitigation methods. The second stage of the EA builds upon the work of the first, especially impact prediction and significance assessment and evaluates alternative forms of mitigation. This two stage EA provides a flexible and effective means of evaluating the impacts of DSM programs and potential mitigation options with limited resources.

8.2 RECOMMENDATIONS

A number of recommendations are made regarding the application of the environmental assessment framework to the power resource and DSM planning process.

8.2.1 DSM PROGRAM EA

In relation to the EA framework that has been developed and tested one recommendation is made:

1. Manitoba Hydro should introduce the Selective DSM EA as a means of performing limited environmental assessments of DSM programs or aspects of DSM programs.

8.2.2 POWER RESOURCE PLANNING EA

Several EA approaches were considered and assessed for application in the power resource planning process. Two of these approaches were not selected because they were the least effective at addressing the concerns regarding DSM programs at their current state of development. However, their elimination does not mean that they are without value to the planning process. Each of these two approaches could make a positive contribution to the planning process. To that end two recommendations are made:

1. That Manitoba Hydro investigate further the costs and benefits of performing a periodic long-range planning EA similar to the Bonneville Power Administration environmental impact statement of its resource programs. Particular interest should be given to the viability of a qualitative form of this EA. This EA would provide Manitoba Hydro with a broad analysis of all its power resource options allowing the utility to identify resource problems at a very early stage thereby minimizing the environmental impacts of developing future resources.

2. That Manitoba Hydro investigate the selective introduction of quantitative analysis for its power resource plan environmental analysis. Specifically there is a need to examine the use of quantitative analysis for environmental costing and determining regulatory compliance of non site-specific resource impacts.

8.2.3 OTHER RECOMMENDATIONS

Two recommendations are made for other areas of concern. The first relates to the program feedback effects possibly resulting from the negative impacts of DSM programs (Conclusion 8.1.1 - 3). In this regard the following recommendation is made:

1. Manitoba Hydro should include the evaluation of program feedback effects in the EA of DSM programs.

A second recommendation addresses the mitigation of impacts outside of the EA process. Mitigation is usually associated with EAs but can be performed in the absence of an EA wherever environmental concerns may warrant and prove to be relatively easily mitigated. In the case of DSM, some programs may have impacts that are too few or to small to warrant the Selective DSM EA that has been developed and recommended in this study. In these cases it would be wise to consider mitigation independently from EA. To that end the following recommendation is made:

2. Manitoba Hydro should take a pro-active role in the mitigation of the potential environmental impacts of DSM programs. Through a partnership with industry and government the net-positive environmental impacts of these DSM programs can be better realized to the benefit of the environment, the DSM programs, and Manitoba Hydro.

References

Akerstream, Tom. 1993. Energy Management, Manitoba Hydro. Personal Communication. March 1993, April 19 1993.

Andrews, R.N.L. 1988. "Environmental impact assessment and risk assessment: learning from each other.". in P. Wathern.1988. Environmental Impact Assessment, Theory and Practice. London: Unwin Hyman.

AOO (Afval Overleg Orgaan). 1992. "Toward A Ten-Year Programme OnWaste Management". in The Netherlands - Canada Workshop on Environmental Impact Assessment - Proceedings of the Workshop April 26-29, 1992. Amsterdam: The Netherlands Ministry of Housing, Physical Planning and the Environment, 195-243.

B.C. Environment, Lands and Parks. 1993. Government of British Columbia. Victoria, B.C., Personal communication. April 14 1993.

Barakat & Chamberlin. 1991. Manitoba Hydro 1991 Long Range DSM Plan - Final Report. December 5, 1991.

Beanlands, Gordon E. and Peter N. Duinker. 1983. An Ecological Framework For Environmental Impact Assessment In Canada. Halifax: Institute for Resource and Environmental Studies, Dalhousie University and Hull:Federal Environmental Assessment Review Office.

Bisset, R. 1980. Methods for Environmental Impact Analysis: Recent Trends and Future Prospects. Journal of Environmental Management. 11(1): 27-43.

Blouin, Tony. April 8, 1993. Director, Environmental Assessment, Environment Branch, Newfoundland Department of Environment & Lands, Government of Newfoundland. Personal communication.

Bodaly, R.A. R.E. Hecky, and R.J.P. Fudge. 1984. Increases in Fish Mercury Levels in Lakes Flooded by the Churchill River Diversion, Northern Manitoba. Can. J. Fish. Aquat. Sci., 41: 682.

BPA. 1988. Volume 1 Environmental Analyses - Final Environmental Impact Statement on New Energy-Efficient Homes Programs - Assessing Indoor Air Quality. DOE/EIS-0127F. Portland:Bonneville Power Administration, August 1988.

BPA. 1992. Draft Environmental Impact Statement Resource Programs - Volume 1: Environmental Analyses. DOE/EIS-0162. Portland:Bonneville Power Administration, January 1992.

Bregha, Francois, et al. 1990. The Integration of Environmental Considerations Into Government Policy. Ottawa: Minister of Supply and Services Canada.

Canada-Manitoba. 1987. Canada-Manitoba Agreement on the Study of Mercury in the Churchill River Diversion.

Canadian Environmental Assessment Act. Statutes of Canada. 1992, C.37.

Clark, Brian D., et al. 1978. Methods of Environmental Impact Assessment. Built Environment. 4, 111-121.

Classes of Development Regulation. Manitoba Regulation 164/88.

Classification Criteria for Products, Substances and Organisms Regulation. Manitoba Regulation 282/87.

Clean Environment Act. Revised Statues of New Brunswick. 1990, C.6.

Contant, Cheryl K. and Lyna L. Wiggins. 1991. Defining and Analyzing Cumulative Environmental Impacts. Environmental Impact Assessment Review 11:297-309.

Dangerous Goods Handling and Transportation Act. Revised Statutes of Manitoba. 1987, c. D12.

Demand Side Management In Canada-1992. 1992. Montreal: Canadian Electrical Association.

DePape Denis. 1993. Senior Policy Analyst, Environmental Policy and Planning Dept., Manitoba Hydro. Personal communication. March 1993.

Dion, T. 1993. Personal Communication. May 1993.

Douglas, Kristen. n.d. Environmental Assessment Legislation: Bill C-78 and Regimes in other Countries. Ottawa: Law and Government Division, Library of Parliament, Research Division.

Doyle, Derek. 1993. Director, Environmental Assessment Branch, Environmental Planning & Protection Division, Ministry of the Environment, Government of Ontario. Personal communication. March 24, 1993.

Dryden, D.W.1993. Director, Environmental Assessment Branch, Ministry of Environment, Land & Parks, Government of British Columbia. Personal communication. March 1993.

Dyck, Harold.1993. Workplace Safety and Health. Manitoba Environment. Government of Manitoba. Winnipeg, Manitoba, Personal communication. May 1993.

Economic Commission For Europe. 1991. Environmental Series 4, Policies and Systems of Environmental Impact Assessment. ECE/ENVWA/15. New York: United Nations.

Edigier, Dave. 1993. Manitoba Environment. Personal communication. April 1993.

Environment Act. Statutes of Manitoba. 1987-88, C.26.

Environment Quality Act. Revised Statutes of Quebec. 1991, C. Q-2.

Environmental Assessment Act. Revised Statutes of Ontario. 1980, C.140, as amended S.O. 1988, C.71, s.18; S.O. 1989 C.71, s.3; S.O. 1989, C.72, s.32.

Environmental Impact Assessment Regulation. New Brunswick Regulation 87-83.

Environmental Protection and Enhancement Act. Statutes of Alberta. 1992, C.E. 13.3.

EPRI and Edison Electric Institute. 1984. Demand Side Management. Vol. 1-3, Final Report. Edison Electric Institute and EPRI.

Eutrotech Ltd. 1991. Used Batteries and the Environment: A Study on the Feasibility of Their Recovery. Report EPS 4/CE/1 May 1991. Ottawa: Minister of Supply and Services Canada, 1991.

FEARO. 1988. Environmental Assessment In Canada, 1988 Summary of Current Practice. ed.,William J. Couch, Federal Environmental Assessment Review Office, Published under the auspices of the Canadian Council of Resource and Environment Ministers, Dec.1988.

Fischer, David W. and Gordon S. Davies. 1973. An Approach to Assessing Environmental Impacts. Journal of Environmental Management. 1(2), 207-227.

Fong, Mark. 1993. California Solid Waste Management Board. Sacramento, CA, U.S.A., Personal communication. April 13, 1993.

Franklin Associates Ltd. 1992. Characterization of Products Containing Mercury in Municipal Solid Waste in the United States, 1970 to 2000. Prairie Village, Kansas: Franklin Associates Ltd.

Gardner, Julia E. 1989. Decision Making For Sustainable Development. Environmental Impact Assessment Review 9:

Gellings, Clark W., and Sarosh Talukdar, eds. 1987. Load Management. New York:IEEE Press.

Generator Registration And Carrier Licencing Regulation. Manitoba Regulation 175/87.

Gibson, Robert B. and Beth Savan. 1986. Environmental Assessment in Ontario. Toronto: The Canadian Environmental Law Research Foundation.

Gordon, Kirk. 1993. Manager, Environmental Impact Assessment Section, Environmental Planning & Sciences, New Brunswick Department of the Environment. Personal communication. April 8 1993.

Grove-White, R. 1984. The Role of Environmental Impact Assessment in Development Control and Policy Decision-Making. R.D. Roberts and T.M. Roberts, 145-152.

Haites, Erik, Julie Hashema and Robert Jean. n.d. "Who Cares About the Environmental Effects of DSM?". n.p.: Abstract. p.309.

Hamlin, Bill. March 23,1993. Generation Planning, Manitoba Hydro. Personal communication.

Hamlin, Bill. March 30, 1993. Generation Planning, Manitoba Hydro. Personal communication.

Hamlin, Bill. Sept. 7, 1993. Generation Planning, Manitoba Hydro. Personal communication.

Hollick, M. 1981. Environmental Impact Assessment as a Planning Tool. Journal of Environmental Management. 12, 79-90.

Holling, C.S. ed. 1978. Adaptive Environmental Assessment and Management. Chichester: John Wiley & Sons.

Jain, R.K., L.V. Urban, and G.S. Stacey. 1980. Environmental Impact Analysis: A New Dimension in Decision Making. 2nd. ed. New York: Van Nostrand Reinhold.

Jansen, Jim. Hazardous Contaminants Branch, Ontario Environment Department. Government of Ontario. Personal communication. Toronto, ON, March 31, 1993.

Kemp, Rob. Alberta Environment Dept. Personal communication. April 14, 993.

Kucera, Emil. March 1988. Guide to Manitoba's Hazardous Waste Legislation. Emil Kucera Ed. Manitoba Environment and Workplace Safety and Health.

La Voie, André. 1993. Director, Policy and Assessment Coordination, Department of Community and Cultural Affairs, Government of Prince Edward Island. Personal communication. March 1993.

Leyland, David. 1992. U.S. E.P.A. Washington D.C. Personal communication. December 1992.

Magos, Laszlo. 1988. "Mercury". in Sigel, Helmut and Hans G. Seiler, ed.'s.1988. Handbook on Toxicity of Inorganic Compounds. New York: Marcel Dekker, 1988.

Manitoba Hydro. Generation Planning Division. 1989. Overview of Selection of Next Supply Addition GP 89-7. Internal document. Winnipeg: Manitoba Hydro.

Manitoba Hydro. Generation Planning Division. 1991. 1991 Power Resource Plan - Phase II Integrated Demand/Supply Option Evaluation.Winnipeg: Manitoba Hydro.

McInnes, Genevieve and Erich Unterwurzacher. 1991. Electricity end-use efficiency. ENERGY POLICY 1991: 208-216.

Meredith, Thomas. 1991. Environmental Impact Assessment and Monitoring. Mitchell, B., Ch.10.

Mills, Evan. 1991. Evaluation of European Lighting Programmes. ENERGY POLICY. April 1991: 266-278.

MOWM. October1992. Fact Sheet - What to do with used fluorescent and high-intensity discharge lamps. Saint Paul, MN: Minnesota Office of Waste Management.

MOWM. 1993. Report on the management of Mercury-Containing Lamps. Saint Paul, MN: Minnesota Office of Waste Management.

Munn, R.E., ed. 1979. Environmental Impact Assessment. Scope 5. 2nd ed. New York: John Wiley & Sons.

Munro, David A., Thomas J. Bryant, and A. Matte-Baker. 1986. Learning From Experience: A State of the Art Review and Evaluation of Environmental Impact Assessment Audits. Ottawa: Minister of Supply and Services.

NEMA. October 1992. The Management of Spent Electric Lamps Containing Mercury.Washington D.C., U.S.A: National Electric Manufacturers Assocation.

Newfoundland Regulation 225/84. The Newfoundland Gazette, Part II. Vol. 59:40.

NRCC. 1979. Associate Committee on Scientific Criteria for Environmental Quality. 1979. Effects of Mercury in the Canadian Environment. NRCC No. 16739. Ottawa: National Research Council Canada.

Ontario Hydro. 1992. Supply-Side Environmental Effects of Ontario Hydro's Demand Management Plan (1992 Update). Report No.: 92162, Exhibit 733, July 1992.

Ontario Hydro. n.d. Providing the Balance of Power. Environmental Analysis. Toronto: Ontario Hydro.

Ontario Regulation 205/87. as amended O.Reg. 521/90.

Pace (Pace University Center For Environmental Legal Studies).1991. Environmental Costs of Electricity. New York: Oceana Publications, Inc.

Phillips Lighting. n.d. Guide to Fluorescent Lamps.

Platis, Helen and Brian McCammond. n.d. "Measuring Environmental Impacts: Options for a New Demand Management Strategy". n.p. 311.

Porter, Rob. 1993. Director, Environmental Support Services Division, Nova Scotia Department of Environment, Government of Nova Scotia. Personal communication. April 8, 1993.

Rees, William E. 1984. Environmental Assessment of Hydrocarbon Production from the Canadian Beaufort Sea. SND #6 Vancouver: School of Community and Regional Planning, University of British Columbia.

Revised Regulations of Quebec. 1991. Q-2/74-76(32).

Robinson, John R. 1991. The proof of the pudding. Making energy efficiency work. ENERGY POLICY September 1991: 631-645.

Rosenberg, David M., et al. 1981. Recent Trends in Environmental Impact Assessment. Canadian Journal of Fishery and Aquatic Sciences. 38:591-624.

Schulte, Fred. 1993. Director, Environmental Assessment, Environmental Protection Branch, Alberta Environment, Government of Alberta. Personal communication. March 1993.

Science Applications International Corporation. 1992. *Analytical Results of Mercury in Fluorescent Lamps.* E.P.A. Contract No. 68-WO-OO27. Falls Church, VA: Science Applications International Corporation, May 15, 1992, Appendix - Table 1. Phase 1.

Seijffers, R.I. 1992. "Some Remarks on EIA for Policies, Programs, and Plans in the Netherlands". The Netherlands-Canada Proceedings, Workshop on Environmental Impact Assessment. The Netherlands: April 26-29, 1992.

SEPA. 1991. Mercury in the Environment, Problems and Remedial Measures in Sweden. Stockholm: Tryckeri Balder AB, Swedish Environmental Protection Agency, 1991

Sheffield, Arthur. 1983. Pollution Data Analysis Division. Air Pollution Programs Branch. Air Pollution Control Directorate. Environment Canada. National Inventory of Sources and Emissions of Mercury (1978). Economic and Technical Review Report EPS 3-AP-81-1. Ottawa: Minister of Supply and Services Canada, 1983.

Sigal, Lorene L. and J. Warren Webb. 1989. "The Programmatic Environmental Impact Statement: Its Purpose and Use". The Environmental Professional. 11: 14-24.

Sigel, Helmut and Hans G. Seiler, ed.'s.1988. handbook on Toxicity of Inorganic Compounds. New York: Marcel Dekker, 1988.

Slemr., F. & E. Langer. 1992. "Increase in global atmospheric concentrations of mercury inferred from measurements over the Atlantic Ocean. Nature. Vol. 355, Jan. 30, 1992.

Sonntag, N.C., R. Everitt, L. Rattie, D. Colnett, C.Wolf, C., J. Truett, A. Dorcey, and C. Holling 1987. Cumulative Effects Assessment: A Context For Further Research and Development. Hull, Quebec: CEARC.

Statistics Canada.1983-1993. Electric Lamps. Cat. No. 43-009, Monthly, Vol.11-21, No. 12.

Statistics Canada. 1990. Report on the Demographic Situation in Canada 1990, Current Demographic Analysis. Cat. No. 91-209E Annual. Ottawa: Statistics Canada, 1990: p.49.

Statistics Canada. 1992. Canada Yearbook 1992. Cat. No. 11-402E/1992. Ottawa: Statistics Canada, 1992: p.82.

Strachan, Larry. 1993. Director, Environmental Approvals Branch, Environmental Management Division, Manitoba Environment, Government of Manitoba. Personal communication. April 8, 1993.

The Environmental Assessment Act. Statutes of Saskatchewan. 1981, C.E. 10.1.

Thompson, Stewart and Riki Therivel. 1991. Environmental Auditing. Working paper no. 130. eds. Stewart Thompson and Riki Therivel. Oxford Polytechnic School of Planning, 1991.

Trask, G.M. and C.E. Hughes. 1985. *Ch.3 Present Landfill Sites.* in Edwin Yee, Emil Kucera, and J.J. Keleher. 1985. Hazardous Waste Management in Manitoba. Manitoba Environment and Workplace Safety and Health, Hazardous and Special Waste Mangement Program, July, 1985.

U.S. Bureau of Census. 1991. Statistical Abstract of the United States: 1991 (111th edition). Washington, D.C., p.7,15.

Utility Environment Report. Oct. 2, 1992. "Mercury in Discarded Lamps Threatens EPA's Vaunted 'Green Lights' Program." n.p.:McGraw-Hill, October 2, 1992, 1,13.

Whitney, Joseph B. and V.W. Maclaren. 1985. A Framework For The Assessment Of EIA Methodologies. New Directions in Environmental Impact Assessment in Canada. Agincourt, Ontario: Methuen, 1985.

World Bank. Environment Department. 1991. Environmental Assessment Sourcebook. Vol. I-III , Tech. Paper No. 139. Washington D.C.: The International Bank for Reconstruction/ The World Bank.

Zalinski, Al. 1993. General Electric Company. Cleveland, Ohio, U.S.A., Personal communication. March 1993.

Zukowsky, R.J. 1993. Director, Environmental Assessment Branch, Planning and Assessment Division, Saskatchewan Environment & Public Safety, Government of Saskatchewan. Personal communication. March 1993.

APPENDIX A

POLICY, PROJECT, AND PROGRAM ASSESSMENT

1. HISTORICAL OVERVIEW

Two decades after the passage of the United States *National Environmental Policy Act* (1970) or NEPA environmental impact assessment has continued to evolve. Three distinct paths of change have been traced: quantification of impacts, new assessment features and approaches, and a wider consideration of impacts.

Assessment methodologies have moved from being largely qualitative towards greater degrees of quantitative analysis (Bisset 1980). There has been much debate as to whether this has improved the quality of the assessments (Bisset 1980, Hollick 1981, Rosenberg 1981).

A general framework has developed for environmental impact assessment. This framework has included impact identification, impact prediction, and the evaluation of project impacts with the impacts of alternatives. New features have been added to this framework for environmental assessment. These have included the auditing of environmental impact statements as well as follow-up monitoring after the approval of a project to verify predictions of impacts and the success of mitigation measures (Munro, Bryant, Matte-Baker 1986).

New approaches to impact assessment have been developed; the ecosystem approach of Beanlands and Duinker (1983) suggests the determination of valued ecosystem components as a means of focussing on impact assessment, and the adaptive approaches of Holling (1978) are prominent in proposing a flexible response to analysis using a variety of methods. These two approaches have been used either together as in the impact hypothesis approach (Everitt, Birdsall, and Stone 1986) or individually as one of many methodologies used in producing an impact assessment. Impact assessment has moved beyond the consideration of only bio-physical impacts to include social and economic impacts (Fischer 1973, Rosenberg 1981). The process of impact assessment has evolved from consideration of primary impacts towards attempts at a more complete assessment of other higher order impacts including cumulative effects.

The consideration of cumulative effects (Gardner 1989) and the need to achieve impact assessment early in the planning process (Grove-White 1984, Holling 1978, Economic Commission For Europe 1991) when alternatives and design changes are more numerous, have both been singled out as reasons for applying impact assessment not only to projects but also to programs and policies.

2. ENVIRONMENTAL ASSESSMENT PROCESSES

2.1 POLICY ASSESSMENT

Policy assessment is discussed first since it is here that assessment resides in the hierarchy of decision making. In terms of its operational use, however, it would more likely come last. Although little policy assessment has actually been done, the subject has been discussed and included in specific legislation mandating environmental assessments (NEPA, Ontario *Environmental Assessment Act*). The European Community has been discussing a draft directive that would promote the use of such assessments for "policies, plans and programmes..." (Thompson and Therivel 1991:15). New Zealand and the United States are among the few countries that have attempted to perform policy assessment to any degree (Douglas n.d. and Bregha et al.1990). Policy assessment can be defined as the determination of the environmental impacts of a wide range of policy alternatives. This form of assessment may sacrifice detail for breadth in order to incorporate a wider range of impacts. Ideally impacts of other policies, programs, or projects producing similar impacts would be considered in order to evaluate possible cumulative impacts. Policy assessment is the earliest form of assessment in terms of the decision making process. Government, however, has been reluctant to allow the environmental assessment of policy on a regular basis according to Bregha et al. (1990:4). Grove-White (1984:150) notes that since government is either directly or indirectly involved in most large projects, the assessment of a government's development policy has been seen as an important influence on the eventual impacts that will be generated in the environment.

One suggestion for policy assessment has been the use of a tiered (multi-stage) approach. The United States Council on Environmental Quality (1985) has indicated that this would involve the use of a series of different assessment processes that would apply at different levels of policy development (quoted in Bregha et al. 1990:10). The earlier levels of assessment would look at broader issues regarding impacts while later assessments, through the benefit of more information, would look at more specific impacts. The use of tiering is valuable in justifying the collective consideration of similar, related, or regionally related actions in relation to their cumulative impact (Contant and Wiggins 1991). Bregha et al. (1990) have indicated that, if applied correctly, the tiered approach would result in less of a "need to return to first principles every time a policy had to be assessed for its environmental impacts". This could also be argued for changes to programs that have already been assessed.

2.2 PROJECT ASSESSMENT

The project assessment initially arose from NEPA and remains the primary type of assessment performed (Jain et al. 1980:3-4). Over the 1980's and 1990's, some program and policy assessment has been performed; however, project assessment continues to prevail as the most common form of EA. In the United States project assessment determines the environmental impacts of "major Federal actions significantly affecting the quality of the human environment" (quoted in Bissett 1980:27). The major actions were predominantly large capital works projects including "roads and highways, watershed and flood control projects, airports, energy-related projects, and parks and wildlife refuges" (Jain et al. 1980:4). Similarly in Canada this is the most common form of assessment (Rees 1984). An example of this type of EA is the assessment of gas exploration on Sable Island or the shipment of oil through Lancaster

Sound (Meredith 1991). In both cases sensitive ecological environments are threatened by energy developments.

As noted, the project assessment has been applied to large, often very large, physical developments. However, large projects are often not singular developments in a region, more often they occur in groups of various sizes, or types, possibly spaced out over several years. In these cases either the projects receive no EA due to their limited size or the EA fails to consider projects related by region or impact type, or future projects related to the current development.

2.3 REGIONAL, SECTORAL AND PROGRAM ASSESSMENT

The regional or sectoral EA processes are attempts to achieve greater efficiency in performing assessments through finding commonality within groups of projects or programs. Their advantages lie in "identifying issues, initiating baseline data collection, and assembling existing data in advance" and in some cases replacing the project assessment (World Bank 1991:12).

The regional assessment as suggested by the World Bank is useful when several "development activities are planned or proposed for a relatively localized geographic area": a watershed is an example of such a region (World Bank 1991:12-14).

Similar to the regional assessment, the sectoral assessment is suggested for use when numerous activities are being planned or proposed within one sector over several years (World Bank 1991), such as agriculture. Sectoral assessments can have other uses: the review of environmental impacts of different investment alternatives, the environmental effects of policy changes within one sector, and finally the consideration of environmental assessment needs, abilities, and institutions within that sector (World Bank 1991).

The World Bank considers "programmatic" or program environmental assessment to fall within the sectoral category of environmental assessment (1991:14). These EAs are applied to a program within an individual sector, a program that will be repeated at various locations with similar impacts at most of these locations (eg., pesticide control of insects in an urban area). The program assessment is similar to the Class Assessment process that has developed from the Ontario Environmental Assessment Act. The class assessment is a limited form of assessment that applies to projects that

> ...pose moderate but not inconsequential environmental impacts...dealing with the difficult grey area between undertakings with potentially major impacts that clearly deserve full assessment and undertakings with obviously insignificant impacts that need not be subject to any formal assessment requirements.... (Gibson and Savan 1986:72).

Sewage treatment plants or an electric transformer station are examples of appropriate projects for class assessment (Gibson and Savan 1986).

3. CONCLUSIONS

As the application of environmental assessment to projects has matured, there is a growing awareness and application of EA to policies and programs. The rules for application to these areas are in the formative stages in most cases and there are a limited number of examples from which to draw guidance. Presently the main focus of efforts regarding EA development is towards earlier assessment, often in the form of policy assessment, when the number of possible alternatives has not been significantly reduced. Another focus is towards making assessment of smaller projects or activities more feasible, and thus more frequently performed. This is evident in the tiered and class assessment approaches. Lastly, cumulative effects are being given consideration by widening the context of assessment to include further similar activities or projects, or activities that produce similar impacts in a specific region or system.

The use of regional, sectoral, policy and program assessment are responses to the need for the consideration of cumulative effects, the earlier application of EA, and the EA of smaller projects and activities.

APPENDIX B
LEGISLATIVE REQUIREMENTS FOR ENVIRONMENTAL ASSESSMENT

1. INTRODUCTION

The legal context for environmental assessment varies from one province to another and from one country to another. This discussion will look at the legal requirements for the application of environmental assessment within Canada and several other countries that are in the forefront of environmental legislation. The consideration of environmental assessment legislation of jurisdictions outside of Manitoba is important in the sense that they can be indicators of possible future requirements that may be adopted by Manitoba and apply to activities in the province. Each jurisdiction applies different means of determining which activities will require an environmental assessment. The primary distinguishing feature of the environmental assessment process of each jurisdiction is its applicability to projects, plans, policies or programs as well as the types of projects, plans, policies, or programs.

2. PROJECT ORIENTATED ASSESSMENT

At the federal and provincial government levels project orientated environmental assessment is the most common form. Canadian federal , British Columbia, Alberta, Saskatchewan, Manitoba, New Brunswick, Nova Scotia, Prince Edward Island, Quebec, and Newfoundland legislation all share a project orientated form of environmental assessment.

2.0 CANADA

Canadian environmental assessment legislation occurs at both the federal and provincial levels. At the federal level is the *Canadian Environmental Assessment Act* (Statutes of Canada 1992, C.37). The Act describes an assessment process that is project orientated. Projects are defined as "a physical work" or "any proposed physical activity not relating to a physical work" as defined in regulations (sec.2(1)). In general an environmental assessment of a project is required when a federal authority is the proponent of the project, provides financial assistance to the project, administers the federal land that is required for the project, or issues licenses or permits necessary for the project to proceed (sec. 5). environmental assessment is also required from crown corporations (sec.8.(1)), and harbour commissions (sec.9.), when those bodies are proponents of a project, provide financial assistance to the project, or administer federal land that is required by the project. Finally, band councils are required to produce environmental assessments when financial assistance is received from a federal source (sec.10.(1)).

2.1 BRITISH COLUMBIA

The province of British Columbia does not have a centralized environmental assessment process. Instead, forty-five separate statutes set out different applications of the environmental assessment process (FEARO 1988). The review and certification of large energy projects is mandated by the *Utilities Commission Act* (1980) which includes the environmental assessment of the project as part of its process (FEARO 1988).

The environmental assessment of policy does not occur within the environmental assessment process at present (Dryden 1993). B.C. Hydro has not been required to perform an environmental assessment of their DSM programs (Dryden 1993). However, it is possible that the B.C. Energy Council may consider the environmental consequences of these programs in the future (Dryden 1993).

2.2 ALBERTA

The environmental assessment process in Alberta is presently in flux. The new *Environmental Protection and Enhancement Act* (Statutes of Alberta 1992, C.E. 13.3) has not been proclaimed. When it comes into force, the Act will apply to designated activities outlined in the Schedule of Activities in the Act. They include the release of substances that can cause adverse effects and other physical projects such as manufacturing facilities, mining, transportation routes, and various land uses. The application of the Act is constrained by the judgement of a Director who decides whether the potential environmental impacts are sufficient to require further analysis (sec. 39). If the proposed activity is not on the mandatory activities list, then the Director must decide if an environmental assessment should proceed or if the activity should be allowed to proceed without assessment (secs. 41, 42(1)). The process in Alberta is project or more specifically "activity" oriented, and no policy or program environmental assessment is required by legislation. The environmental assessment of utility energy conservation programs has not occurred (Schulte 1993).

2.3 SASKATCHEWAN

The Saskatchewan environmental assessment process is guided by *The Environmental Assessment Act* (Statutes of Saskatchewan 1981, C.E.10.1). The Act provides for the screening of projects to determine if an assessment is required and if so, the form of assessment that should be performed (FEARO 1988:27). The Minister determines whether the requirements of the Act have been met and development may proceed (Statutes of Saskatchewan 1981, C.E.10.1: sec. 15(1)). The Saskatchewan legislation restricts environmental assessment to projects. This is evident in the definition of development which refers to "any project, operation or activity or any alteration or expansion of any project, operation or activity" that is likely to produce any of a number of effects (sec.2(d)). These effects include impacts on "unique, rare or endangered feature of the environment", consuming large quantities of provincial resources, emitting pollutant not regulated by other legislation, generating public concern, introducing new technologies in the field of resource use, and in general having a "significant impact on the environment" (sec.2(d)). Programs and policies have not been assessed using the Act (Zukowsky 1993).

2.4 MANITOBA

The environmental assessment process in Manitoba is set out in the *Environment Act* (Statutes of Manitoba 1987-88,C.26). This is a licensing process that involves environmental assessment only for some projects. A whole range of lesser actions may be first required of project proponents. These actions include obtaining additional information about a project, requiring further study by the proponent, requiring detailed plans regarding environmental protection and management, requiring public meetings or hearings, providing guidelines and instructions to a proponent for performing environmental assessment including public consultations, or requiring a review of the assessment report. Any number of these actions may be required from proponents depending upon the class of the project, the judgement of the Director and in some cases the Minister.

This process is project driven; defining developments as "any project, industry, operation or activity" or "any alteration or expansion of any project, industry, operation or activity which causes or is likely to cause" a number of effects (sec.1(2)). These effects include the following: using a technology for resource use that may cause environmental impacts; the use of a natural resource that may affect the use of that resource for other purposes; the release of a pollutant, industrial by-products, or wastes into the environment; effects on unique, rare, or endangered features of the environment; a significant effect on the environment either through the initial or a later development; and lastly significant effects on the social, "environmental health", or "cultural conditions" of people (sec. 1(2)).

A regulation created under the Act known as the *Classes of Development Regulation* (Man. Reg., 164/88) provides a list of class 1,2, and 3 developments that are required to seek licenses in order to proceed. The discretion to place a specific development into one or another class is that of the director and is determined on the basis of the "examples or the criteria or both" for each class as listed in regulations (sec.1(2)).

Developments within class 1 are those whose effects are primarily related to the release of pollutants; these are typically cement plants, grain elevators, foundries, among others (Man. Reg., 164/88 sec. 2). Class 2 developments are those whose effects are not primarily related to the release of pollutants; these include mines, smelters, recreational developments, electric generating stations (less than or equal to 100 MW), some hydro-transmission lines, among others (sec.3). Class 3 developments are developments whose magnitude or whose number of environmental impact "issues" make them "exceptional projects" (sec.1(2)). Examples of class 3 developments include electric generating stations (greater than 100 MW), mining facilities, some transportation and transmission corridors, as well as large water developments (sec.4). There is some flexibility in allowing developments to be moved from class 1 to class 2 and from class 2 to class 1 or 3 if the Director feels it is appropriate (secs.10(6),11(8)).

Although the Manitoba environmental impact assessment process is project driven, and policy and programs do not presently receive environmental assessment, there are two possible avenues for the assessment of the provincial utilities energy plan. The first is that the utility could voluntarily submit the power resource plan to the assessment process; another option that is currently being considered is that the need and justification of the plan should be discussed, although possibly outside of the environmental assessment act (Strachan 1993).

2.5 QUEBEC

The Quebec *Environment Quality Act* (Revised Statutes of Quebec 1991, C. Q-2) is similar to the Manitoba licensing process except that there are two groups of projects rather than three classes. The first group are industries or activities that are of concern regarding possible release of contaminants or a change in the quality of the environment. This group requires a certificate of authorization from the Minister in order to operate. Prior to providing the certificate the Minister may request information, further study, or an assessment statement from the proponent.

The second group are those that may require environmental assessment. The act provides for the environmental assessment and review of "any construction, work, activity or operation, or carry out work according to a plan or programme" as described by regulation (s.31.1). Projects are placed into two further groups by regulation (Revised Regulations of Quebec 1991: Q-2/74-76(32)): those projects that are automatically subject to the environmental assessment and review process (schedule A) and those that are exempt from the process (schedule B). The types of projects that require an environmental assessment are similar to those in Manitoba. These include large hydro-electric projects, fossil fuel power plants, and large land-uses. The projects that are exempt from the process are generally smaller land uses and smaller scale projects. The form of environmental assessment that is required from a proponent is at the discretion of the Minister.

2.6 NOVA SCOTIA

Nova Scotia's environmental assessment process is also project driven. The *Environmental Protection Act* and the *Water Act* both require environmental assessment of undertakings that may have a significant impact on the environment (FEARO 1988,49). These undertakings can be either class 1 or class 2 (Porter 1993). Class 1 includes such projects as mines, fish meal plants, and small transportation corridors (Porter 1993). Class 2 undertakings include thermal electric power plants, oil refineries, incinerators, and cement plants (Porter 1993). The provincial utility has not been required to conduct environmental assessments of its demand side management programs or its long-term energy plans (Porter 1993). It is possible, although unlikely, that they may be required to do so in the future (Porter 1993).

2.7 PRINCE EDWARD ISLAND

Prince Edward Island's *Environmental Protection Act* (1988) requires environmental assessments from proponents of undertakings (FEARO 1988). The Act's definition of undertaking includes "any construction, industry operation, or any change to an existing undertaking that may adversely affect the environment, in general, or a special feature of the environment, emit a pollutant, or cause public concern because of its real, perceived or potential effect on the environment" (FEARO 1988:51). The province's *Electric Power and Telephone Act* requires the public utility to produce an environmental impact assessment when it proposes construction, extension, or addition to lines, plants or systems where the cost exceeds $5000. There has been no discussion of doing EA of demand side management programs (La Voie 1993).

2.8 NEW BRUNSWICK

The environmental assessment process in New Brunswick applies to "undertakings" in the *Clean Environment Act* (Revised Statutes of New Brunswick 1990 C. 6). These are defined as "enterprises, activities, structures, works or programs explicitly specified in the regulation" (FEARO 1988:45). The New Brunswick *Environmental Impact Assessment Regulation* (N.B. Reg., 87-83) specifies these undertakings as those that may result in significant environmental impacts. These include large industrial facilities such as electrical generating facilities, mines or mineral processing facilities, large land uses such as major residential developments, highways, sewage disposal facilities, and provincial or national parks (Schedule A). The inclusion of the term "program" to define an undertaking has been applied in only one case, "all programs or commercial ventures" related to the introduction of non-indigenous plant or animal species into the province (Schedule A). Energy conservation programs or long-term utility energy plans have so far not been mentioned in the regulations or assessed by the Act (Gordon 1993). However, one option is available, to have the environmental impacts of the energy plan considered by the provincial Round Table on the Environment and the Economy (Gordon 1993).

2.9 NEWFOUNDLAND

Newfoundland's *Environmental Assessment Act* (1980) sets out the environmental assessment process (FEARO 1988). The definition of an undertaking includes any "enterprise, activity, project, structure, work, policy, proposal, plan or program that may, in the opinion of the Minister, have a significant environmental impact..." (Newfoundland Regulation 225/84, sec.2). Individual undertakings or classes of undertakings may be exempted under the Act or the regulations (sec.3). As well the Minister or the Regulation may declare an "enterprise, etc." an undertaking (FEARO 1988:53).

Presently, regulation 225/84 includes a list of undertakings that range from fishing and logging to manufacturing, construction and utilities of various types. The Act can be applied to programs, policies, and plans but has not been as yet (Blouin 1993). Utility demand side management programs would not be assessed due to their lack of significant environmental impacts (Blouin 1993). Long-term utility energy plans have not been assessed (Blouin 1993).

Although it is possible that the environmental assessment process could be extended to policies, programs, and plans in the energy sector, this is difficult because the process is site orientated and its "mechanisms are not applicable" to their assessment according to the director of environmental assessment (Blouin 1993). He suggests that a new "mechanism" is required for these types of assessments (Blouin 1993).

3. POLICY, PROGRAM AND PROJECT ORIENTATED ASSESSMENT

There is a second group of assessment legislation that includes the assessment of policies, programs and plans as well as projects. The province of Ontario as well as the United States are part of this group.

3.1 ONTARIO

The Ontario environmental assessment process is established by the *Environmental Assessment Act* (Revised Statutes of Ontario 1980 C.140). The Act applies to both public and private undertakings. In terms of public undertakings it applies to "enterprises or activities or proposals, plans or programs in respect of enterprises or activities..." of government agencies, public bodies and municipalities (sec.3(a)). The private undertakings that it applies to include "major commercial or business enterprises or activities or proposals, plans or programs in respect of major commercial or business enterprises or activities of a person or persons..." (sec.3(b)). The undertakings that are subject to the environmental assessment process of the Act are limited by regulation and the provision of exemptions to certain undertakings as defined by the Minister (sec. 29). For example, Ontario Hydro is defined as a public body by regulation (O.Reg., 205/87, sec.3). Ontario Hydro has also received an exemption from the assessment process for the construction of its Nuclear Generation facility at Darlington (Doyle 1993). The Act allows proponents to apply for a class assessment of an undertaking as opposed to the individual environmental assessment. The Class environmental assessment is for undertakings that share "common characteristics, are carried out in very similar circumstances, recur frequently, and have a predictable range of effects" (FEARO 1988:35). This form of assessment creates a set of procedures that are required of proponents to fulfill the requirements of the Act each time they propose one of these specific undertakings (FEARO 1988). If significant environmental effects warrant, the Class environmental assessment may be expanded to involve an individual assessment of an undertaking.

Although the Act came into force in 1976, it is only recently that policies, programs and plans have been assessed under the provisions of the Act (Doyle 1993). Public and political pressures forced the act to be applied initially in the early 1980's on the provincial timber management plan and later in 1988 when Ontario Hydro's demand supply plan was assessed by the process (Doyle 1993). The Ontario Act requires consideration of not only alternative methods of implementing an undertaking but also alternatives to the undertaking (Doyle 1993). Ontario Hydro was required to consider alternative methods of providing increased electrical supplies through various sources such as solar, thermal, nuclear, wind, and private sector generation of electricity (Doyle 1993). This provision also required that Ontario Hydro consider demand side management as an alternative to increased development of supply side sources (Doyle 1993).

3.2 OUTSIDE OF CANADA

Outside Canada, the application of environmental assessment to policies, plans, and programs as well as projects appears to be occuring. In the United States, the National Environmental Protection Act (NEPA), the source of American environmental assessment activities, requires assessment from "major federal actions significantly affecting the quality of the human environment" (Douglas n.d.:27). This legislation does not exclude non-physical actions (Douglas n.d.:27). An example of a program or plan assessment is the draft environmental impact statement (DOE/EIS-0162) of the resource programs of the Bonneville Power Administration. The same federal agency performed an environmental assessment of a specific energy conservation program that involves weatherization of housing (DOE/EIS-017F).

In the Netherlands, about thirty policy, program, or plan environmental assessments have been completed (Seijffers 1992:175). The primary focus of these environmental impact assessments was regional waste management plans, regional plans for extraction of sand and gravel, a ten year waste management plan, electricity supply plan, and a drinking and industrial water supply plan and program (Seijffers 1992:175).

4. CONCLUSIONS

At both the federal and the provincial government levels in Canada the director of the department in charge of environmental assessment has the final decision on which project will require an environmental assessment. The director is aided in this decision by lists that suggest, exempt, or mandate assessment for a particular activity. However, these lists can be changed and the legislation often allows them to be overridden should the director consider it necessary. If concerns over the impacts of DSM programs were expressed to a sufficient degree it is possible that these programs could be required to produce environmental assessments. Given the non-serious nature of the impacts related to DSM programs it is unlikely that environmental assessment of DSM programs would be required. It is more likely that the long-term power resource plan of any utility may become the object of criticism by the public and interest groups should controversial energy options be contemplated. In this case, DSM, as part of the resource plan of most utilities will be assessed.

An example of the environmental assessment of a utility power resource plan is the environmental assessment of Ontario Hydro's supply plan. It may be that the controversy regarding this power plan was only a trigger for the expansion of the assessment process to considering plans and programs. Ontario seems to be continuing on the path to assessing large plans and programs such as Ontario Hydro's power resource plan under its Environmental Assessment Act. It is in the interests of a proponent to do plan assessment both to identify mitigation at an earlier stage and possibly to avoid the need for individual project assessments and to allow compliance and control legislation to deal with emissions and other impacts (Doyle 1993). Newfoundland has the ability to do so under its present legislation but has failed to exercise any of these powers as yet.

The application of environmental assessment to programs and policies as well as private sector projects has been slow, both in Canada and the World. Beyond the flexibility available to provincial and federal governments in applying existing legislation there is the possibility that legislative changes may occur in the future. Another possible route for the evolution of environmental assessments could be the addition of separate processes specifically designed for less site-specific assessments. It was suggested that the present environmental assessment process was not an appropriate method for looking at the long-term energy plan of a utility (Blouin 1993, Gordon 1993, Strachan 1993). Manitoba is exploring the idea of changing or adding to its assessment process in order to consider the energy supply/demand plans of Manitoba Hydro.

APPENDIX C

UTILITY SURVEY RESULTS

1.O GENERAL OVERVIEW OF SURVEY

Determining the present and anticipated practice of DSM program environmental assessment (EA) was the main objective of the utility survey. The questionnaire included general questions about EA as well as more specific questions about the process itself including EA constraints, the identification of impacts, prediction of impacts, evaluation of impacts, the consideration of alternatives as well as mitigation and monitoring.

Utilities were chosen through three different methods. Canadian utilities were chosen from the Canadian Electrical Association publication Demand Side Management in Canada - 1992 which listed utilities that were pursuing DSM programs. A few other Canadian utilities were added for diversity since the above publication listed mainly the larger utilities while omitting some of the smaller municipal utilities. The American utilities were chosen from energy journal articles that identified the utilities that had developed DSM programs. Other American utilities were added after consulting a list of utilities with active DSM programs in the Manitoba Hydro 1991 Long Range DSM Plan - Final Report . Utilities outside of Canada and the United States were identified through energy journal articles and later by referrals from utilities that received the questionnaire. Several of the utilities outside of Canada and the United States were added to the questionnaire list without knowing if they had an active DSM program in order to garner a wider range of experiences working on the assumption that DSM programs would be in place at a number of the chosen utilities.

The questionnaire was sent out to 155 utilities in Canada, the United States, and other countries including the Republic of Ireland, Sweden, Norway, Switzerland, Denmark, Belgium, Netherlands, Germany, United Kingdom, Australia and New Zealand (Table C1). Overall there were responses from 30% of the recipients. The highest response rate was in Canada where 43% responded, the United States was slightly lower with 28% responding, and the lowest were all other countries where only 22% responded.

It is likely that Canadian utilities were motivated to respond due to their nearness to the researcher. Secondly, Canadian utilities are in many cases very large utilities with larger staffs that are more able to respond to a lengthy questionnaire. Canadian and American utilities also share a common characteristic that more actively motivated them to respond to the questionnaire: they are the most active in demand side management programs as well as in implementing innovative methods in utility planning. Many of the European (as well as the New Zealand) utilities voiced a common difficulty in answering the questionnaire either because they do not have DSM programs at present, or because they do not

Table C1 - Survey response

Region	No. Sent	Returned & Completed	Returned & Uncompleted	Ret. & Comp. (Not Used)	Total	% Sent
Canada	42	11	6	1	18	43%
U.S.A.	46	9	4		13	28%
Other	67	8	7		15	22%
Total	155	28	17	1	46	30%
	% Sent	18%	11%	1%		

consider environmental effects in their utility planning beyond basic compliance with regulations and standards. A further reason for the lower response from the European utilities is that some may not have had qualified people able to respond to an English questionnaire. It is notable that no response was received from any of the German utilities.

The responses were classified according to four types for the sake of analysis, all with varying rates of response (out of 100%):
(1) those questionnaires that were returned and completed (18%);
(2) questionnaires returned and completed but not included in the analysis due to the acceptability of the data (1%);
(3) responses with questionnaire not completed (11%). The questions were of both multiple choice and long answer forms with many of the multiple choice providing room for additional comments (see sample questionnaire in section 3).

Analysis of the responses to individual questions is made difficult by two factors. First, although the response rate of 15 should mean that 15 responses were given for each question, not all questions are answered in all cases. Often a respondent would skip large sections of the questionnaire, possibly due to a specific type of expertise (eg. power planning engineer as opposed to a an environmental specialist), perhaps an attempt to answer only the easier questions, or a lack of clarity in the question. Either way, this has resulted in some questions producing too few responses to make any conclusions possible. In some cases this has been alleviated by comments that were given by the few who answered these questions. For those questions where both comments and multiple choice answers were infrequent this will be indicated and no conclusions will be drawn. The second factor influencing the results occurs when respondents have chosen more than one answer. Therefore a particular question may have 17 responses even though only 15 surveys were completed.

The more pronounced difficulty in interpreting the data is produced by the split structure of the questionnaire. Since the questionnaire had three parts, with part A to be completed by all respondents, part B to be answered by those who had done EAs (EA Group) and part C to be answered by those who had not (Non-EA Group), the responses to individual questions were further limited. This has been alleviated to some extent by the fact that the long answer questions were answered in detail by the EA Group. This is not surprising, nor is it surprising that a greater number of additional comments were received from this group. The greater number of questionnaire responses from the Non-EA Group presents a difficulty in terms of interpretation of responses. Since this group has not performed EAs their answers to questions need to be contrasted with those who have such experience. It is likely that many, if not most of the answers by the Non-EA Group are conjecture and can only be used in conjunction with similar answers (if available) from the EA Group.

Part C of the questionnaire had more non-multiple choice questions and fewer questions than part B (Non-EA Group). Although many were similar to the questions given to the EA Group others were dropped or replaced to adjust for the more limited experience of those responding to the questionnaire.

In the following discussion of the responses only a summary of the data will be included. The detailed data can be found in section 2. Relevant comments from respondents will be included below; these include general comments, additional comments to multiple choice questions, and non-multiple choice answers. The group responding to a question or in some cases several questions is denoted following the list of questions being considered. This will facilitate the comparison and contrast of respondents who have performed EAs with those who have not. Although answer preferences are derived from a relatively limited number of responses for the sake of clarity percentages out of 100 will be given for each question. Included in the percentage total is a category of response called no response (NR) which denotes the percentage of respondents not answering that particular question.

2.0 RESPONSES

2.1.0 General Questions: (questions A-1, B-1, C-1, C-2)

All Respondents (q. A-1)

The first part of the questionnaire (Part A) was a mechanism for diverting respondents to the section of questions relating to their EA experience with DSM programs. Respondents were asked if environmental assessments of the utility's demand side management programs have been performed. Over one quarter (29%) responded yes while just over two-thirds (68%) responded no to the first question [NR=5%], out of a total of 28 responses.

Several questionnaire recipients provided comments regarding this question on a letter, in some cases without completing the questionnaire. Three of these comments are summarized below.

- The real need is to develop a resource effective framework for environmental assessment of DSM programs. Such a goal would contribute more to advancing the state-of-the-art and getting industry involved in doing environmental assessments.
- The Sofia and Helsinki protocols (attempting to reduce NOx and SOx emissions) influenced our decision to implement DSM. After the implementation of integrated resource planning as a method of capacity planning we will be able to assess the impact of our DSM program on these "wider" environmental issues.

- The local impacts of Tungsten lamp replacement programs using compact fluorescent lamps and energy efficient fridges are thought to have no significant environmental impact.

After this first question all responses are from one of two groups of respondents the EA Group (ie. utilities that perform DSM EAs) and the Non-EA Group (ie. utilities that do not perform DSM EAs).

Non-EA Group (question C-2)

One quarter of the Non-EA Group indicated that they intended to do EA work on their DSM programs [25%: NR = 6%].

- If DSM is used in the U.K. it is likely that an EA will be done since the environmental impact of present business activities are "reviewed".
- We may do some in the future , but it is undetermined whether we will have time, money, or methodology to do a meaningful assessment.
- We believe EA should be factored into DSM evaluations.

2.1.1 Scope of EA

EA Group (question B-1)

Respondents were asked for a brief description of the scope of the assessment and the level of detail of the analysis. EAs were characterized by respondents in several ways:

- Identification and comparison of the emissions from different resource options and the quantification of total emission levels of resource plans with different combinations of supply-side and demand-side resources.

- Inclusion of environmental externalities in the development of DSM programs.
- The continuous review and assessment of environmental impacts of implementing a variety of DSM measures in relation to meeting state and federal regulations.
- A qualitative evaluation in most cases, although quantitative analysis may be used in the case of load growth programs. In cases where customers introduce new electric technologies and displace non-electric technologies load growth is offset by reduced emissions from the user of the technology. In other cases like refrigerator buy-back programs the management of CFCs needed to be addressed.
- A means to encourage proper disposal of potential hazardous waste.
- A means of linking environmental benefits to society to the utilities DSM programs.
- Our residential refrigerator program needed to consider the trends in environmental regulation, disposal techniques, and available infrastructure.
- A prototype community retrofit program investigated the environmental implications of all retrofit measures.
- Investigations were carried out on environmental regulations and trends affecting energy management in all sectors.
- No complete EAs have been done on our utilities DSM programs.

Non-EA Group (question C-3)

Non-EA respondents failed to provide many descriptions of EAs that would be performed; those included were rather vague.

- Difficult to say, however it will likely include energy & emission savings, reduced requirement for generation/distribution plant. Economic welfare benefits.
- Cost and impact of pollutant reductions.
- An integrated resources assessment would analyze environmental impacts of supply and demand resources. This would include environmental impacts from the manufacturing/refining process through operation to disposal.

2.1.2 Reasons for Performing EAs:

EA Group (question B-2)

EA Respondents were asked to give their reasons for performing assessments. Some of the answers to the previous question (question B-1) actually answer this question as well; they are italicized below.

- To assess the impact of DSM programs on emission levels.
- To identify the true costs of implementing our programs to the utility and to society. In order to determine whether or not a program is cost-effective, we need to consider all the environmental impacts, whether they are negative or positive.
- Environmental impacts are assessed for all energy resource options as a standard procedure.

- To gain greater participation in a refrigerator buy-back program by disposing of the refrigerants in an environmentally sound manner.
- To ensure that health hazards to occupants did not result from the encouragement of building weathersealing.
- Programmers must be aware of regulations to ensure compliance and must be aware of trends in regulations for energy management planning purposes.
- *A means to encourage proper disposal of potential hazardous waste.*
- *A means of linking environmental benefits to society to the utilities DSM programs.*
- *Our residential refrigerator program needed to consider the trends in environmental regulation, disposal techniques, and available infrastructure.*

Non-EA Group (question C-1).

Various reasons were given to explain why Non-EA respondents have not performed EAs. Some of these reasons were given in answer to the next question (question C-2(b)); they are italicized below.

Many of these reasons fell into two groups, either DSM was not employed presently or DSM programs had not yet been implemented. Other common explanations were the lack of staff to do an EA, the cost of evaluations, as well as the lack of a requirement to perform one. There were other more elaborate reasons:

- Pricing already includes environmental signals.

- Our programs reduce consumption resulting in reduced emissions and use of land, etc. KWH savings can be translated into reduced emissions of CO_2, NOx , etc. but this is not done on a regular basis.
- Potential impacts of a major or practical significance are handled during the implementation of the DSM program.
- No methodology on which to base assessments.
- Projects and programs are relatively small.
- Has not been considered by the company or by regulators and has not been as important as getting high quality DSM programs operating.
- Don't know the monetary value of a reduction in pollution.
- People are already "environmentally friendly" through participation in DSM programs.
- *Cost, limited need has been identified.*
- *Too early in program.*
- *EA will be done only if required. At worst the DSM programs delay the need for new generation and at best eliminate it altogether. Little real negative impact from the programs, however there is a very positive impact. Negative impacts are small, including the manufacture of energy efficient products. These can be cancelled out by the use of DSM materials themselves.*
- *No clear demand or direction to do so. Some environmental decisions are currently considered in our program decisions, but are not based on a formal environmental assessment.*

- *We are implementing a prototype DSM program as part of an Integrated Resource Planning study that considers demand parallel with generation options. However, it is the generation side that will require the EAs.*

Analysis

There are four general types of EA that are being used by utilities with DSM programs. They differ in terms of the breadth of the issues they examine as well as the level of detail. Many of these are not traditional types of EA as described in Appendix A, but they are being used to accomplish one of the objectives of EA - determining environmental impacts and including them in the decision making process.

One type is a planning tool that looks at the emissions of both demand and supply side resources in order to limit emissions; this can be both quantitative and qualitative. A second similar type involves the inclusion of environmental externalities in the development of supply and demand resources. A third type is the issue-oriented EA where a program is studied in relation to any of its perceived environmental impacts. This type of assessment usually determines the seriousness of a problem, what relevant regulations or liability issues apply, and finally considers possible mitigation measures. It may consider any or all of these issues related to that program. A fourth type is issue oriented but considers an issue related to all programs, both supply and demand. Examples have been given of assessments of trends in environmental regulations.

An interesting aspect of these environmental assessments is that some of the reasons for performing them go beyond the traditional focuses of EA, being the identification, prediction, evaluation, and mitigation of a program's environmental impacts. One respondent identified environmental assessment as a marketing tool that provides the information required to motivate people to participate in DSM programs. Another indicated it as a means of promoting the proper management of hazardous wastes.

2.1.3 Who Performs EAs: (questions B-3,C-4,C-5)

EA Group (question B-3)

Environmental assessments were performed in most cases by utility DSM departments [45%], as well as utility environment departments [9%], outside consultants [18%], and others [27%]. All responded to this question [NR=0%]. Consultants produced reports on indoor air quality of multiple residences as well as on electric technologies that benefit the environment.

Non-EA Group (questions C-4, C-5)

Less than one-half [41%] of the respondents indicated that they had some environmental expertise within their utility while a similar percentage [41%] indicated they did not (question C-4), fewer indicated other [6%] and two gave no response [NR=12%]. Over one-third [37%: NR=16%] of the respondents to the next question (question C-5) indicated outside consultants would perform any environmental assessment, fewer [21%] indicated an outside agency would be involved. One indicated that it would be an effort undertaken by a combination of departments within the utility ranging from the environment department to the resource planning department, the DSM department, and other parts of the utility.

2.1.4 Effect of EA on DSM program: (questions B-4, C-6, B-5, B-8, C-8)

EA Group (question B-4)

Respondents were asked how the results of the EA influenced the design of their DSM programs.

- None.
- It justifies some programs.
- We try to offer programs that are environmentally beneficial to our customers (or society in general). If the program must incur greater costs to account for additional costs due to disposal regulations, standards, etc. Then the program may become less cost-effective. The program(s) may be eliminated or modified for the next program year.
- Programs are designed to minimize environmental impacts as much as possible within reason.
- It resulted in additional training of contractors in some cases and in others changed requirements to be met for incentives.

Non-EA Group (question C-6)

Although many felt it was too early to determine how the results of an EA may affect a program's design others had definite opinions.

- DSM attributes that produced the most appropriate reward to the greatest degree would be concentrated on.
- Depending upon the outcome of the assessment, the results could possibly provide the legal force behind further requests for assessment.
- Influence the design of the program to the point of modifying the project within budget.
- Programs with minimal environmental impacts would be favored over more damaging programs.
- If results from an EA benefited the program, they could be passed on to Government to determine if the utility would be allowed to pay for the programs out of a new tax on "users" of the environment. This would decrease the impact of DSM on rates and allow the costs to be bourne by the people responsible for using the environment.
- We are required to include the environmental externalities of costs of supply when evaluating supply and demand resources. If an EA suggested they should be included for demand side resources then they would be used in selecting least-cost resources.

EA Group (question B-5)

As a further question they were asked if the results of the EA influenced the time required to implement their DSM programs.

- None
- In one program where we had to investigate the proper disposal of CFC-11 foam, it has delayed the program by one year.
- No impact on timing of DSM to date.
- It adds to the time required for developing the programs and in some cases to the time required for energy efficiency upgrades.

Non-EA Group (question C-8)

Several Non-EA respondents noted that the time required to implement DSM programs was likely to lengthen as a result of an EA. However others noted it was too early to tell how the EA would impact the programs.

Analysis

There were several ways that the EA was expected to or already had altered the design or timing and costs of the DSM programs. It is interesting that although some felt that the programs would take longer to implement and with increased costs; a few suggested positive changes to programs. Where positive impacts were identified they could provide added justification for a program, in other cases program changes could occur to the training of contractors and to program guidelines in response to the concerns of the EA. The alteration of programs is an indication that an EA on DSM programs can produce useful information for the development of these programs.

2.1.5 Placement of EA in Planning Process: (questions B-6, C-9)

EA Group (question B-6)

Respondents were asked about where EAs were performed within the utility planning and decision-making process. There was a wide range of answers indicating that assessments occurred at all levels of planning with some weighting towards the end of the planning process (Figure C1). Two comments were made about the placement of EA.

- EA is done for each program.
- Developing regulations at the federal level are often motivations to conduct EAs.

Non-EA Group (question C-9)

The placement of an EA within the utility planning process was the subject of another question. Respondents failed to indicate a strong preference for any stage of the planning process (Figure C2), although the largest number of respondents felt that EA should occur when the overall and individual DSM program plans are made. One respondent suggested the EA should occur within the integrated resource plan.

Analysis

Each group indicated different utilities may use any of the planning process levels for an EA process. The preference that both had for the latter part of the process is not unusual since this is

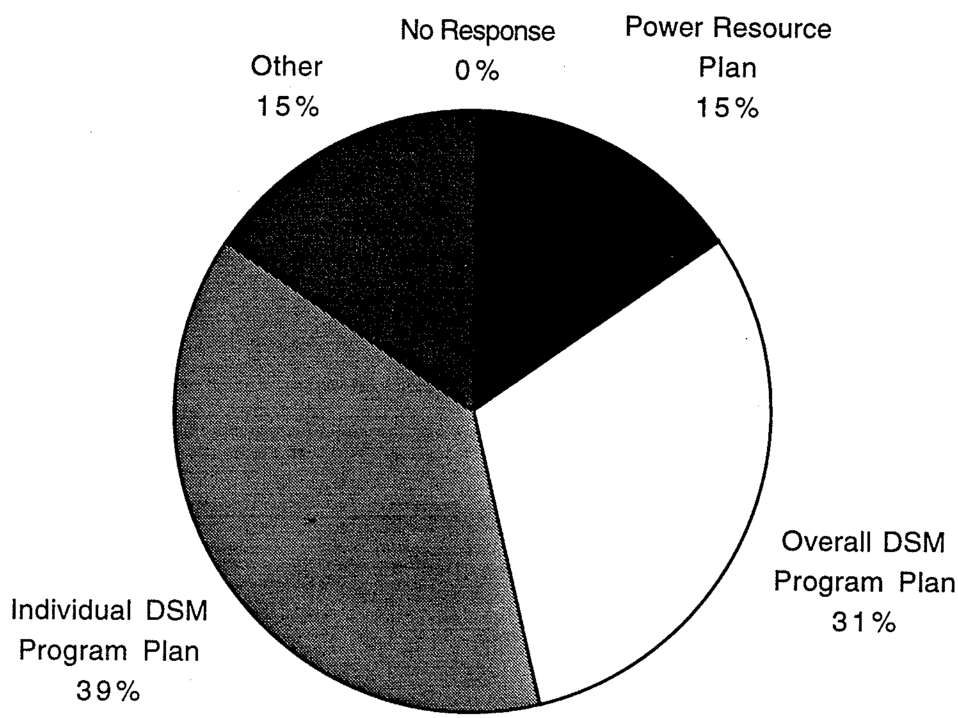

Figure C1 EA placement in the planning process
EA Group (Question B-6)

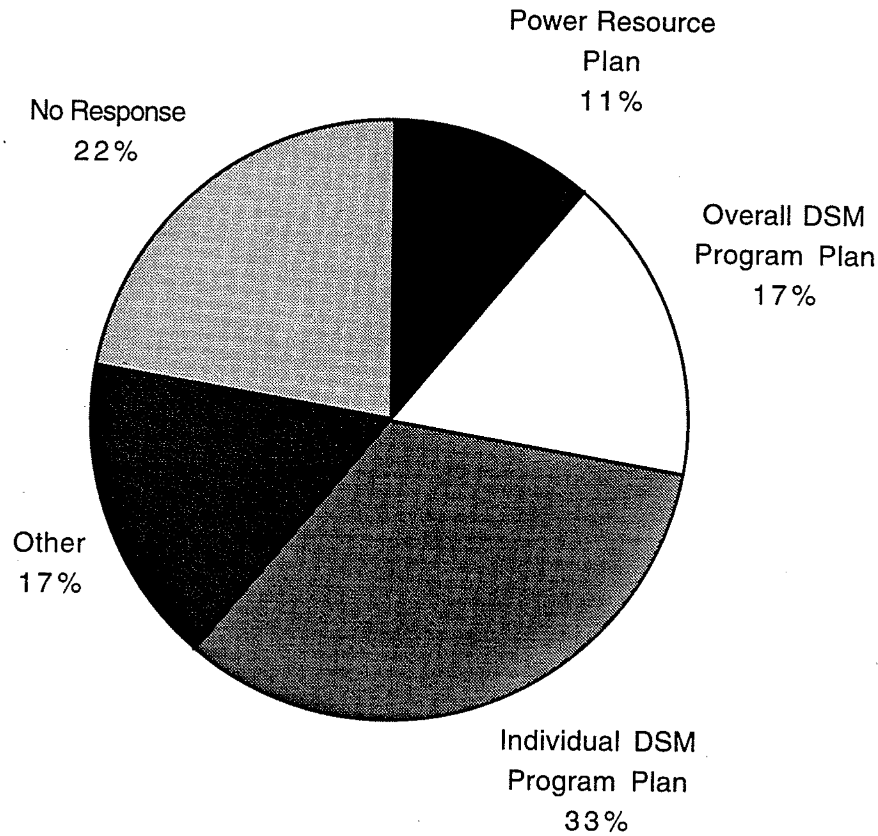

Figure C2 EA placement in the planning process
Non-EA Group (Question C-9)

where the project assessment that is the basis for EA experience is generally performed.

2.1.6 Tiered EA structure: (questions B-7, B-8, C-10, C-11)

EA Group (question B-7)

Another related question attempted to determine if "tiering" or the performance of different types of assessment at different levels of the planning process was being used by any utilities. Only one response out of 8 [13% : NR=25%] indicated that any tiering occurred. Comments noted the problems with this EA framework and the way a utility planning process uses it in a limited way.

- Sometimes the EA is not made or cannot be resolved until the program has reached a more mature stage - and an understanding of the technology is achieved through experience.
- Individual programs are designed first and then submitted as possible energy resource options in the Integrated Resource Plan. The initial designs recognize some environmental aspects. These may be refined by the Integrated Resource Plan and/or the final implementation plan.

EA Group (question B-8)

Several reasons were given for not using tiering.

- DSM programs have only moved to the pilot program stage and implementation is years away.

- Sometimes, because of Superfund liability issues, we must proceed with caution on any environmental issue or policy.
- Lack of resources.

Non-EA Group (question C-10)

Non-EA respondents were asked whether environmental assessment would use a tiered structure that would involve more than one assessment, with later assessments having more detailed analysis. Responses were split with only a small number indicating yes [13%] or no [27%] and the remainder indicating other [33%] and no response [27%]. One commented that if money were available then each program would have to be studied individually.

Non-EA Group (question C-11)

Several reasons were given by respondents for deciding against the use of EA tiering. One respondent indicated that a detailed analysis of individual programs would be able to identify the most environmentally beneficial programs and therefore the best to implement. Another suggested that tiering would be difficult for economic reasons.

Analysis

As noted above only one limited case of tiering occurred. Many of the respondents would seem to have had little experience with tiering. The suggestion that it requires more resources is likely flawed because it is premised upon tiering being a collection of equally large EAs which, as indicated in the discussion of environmental assessment (appendix A), it is not. Others noted that in order to do an EA, information was required from the full development of the DSM program and experience with that program. However, this again is premised on each EA requiring a complete set of information which again is not the case.

It should be noted that it is possible that tiering was a more popular concept amongst Non-EA respondents because they may lack entrenched opinions about EAs, or possibly it is because of the larger sample, or both.

2.1.7 Public Participation: (questions B-9, C-12)

EA Group (question B-9)

The degree of public and interest group involvement in the DSM environmental impact assessments was mainly limited to public hearings [40%], surveys of public opinion [10%], no public involvement [10%], and other venues [30%] including special advocacy groups representing the public. Only a few [10%] gave no response. There were two examples of hearings.

- Regulatory hearings that review integrated resource plans and associated DSM. Here the focus is not on environmental assessment in the same way that an EA might be conducted for a supply side option, but environmental impacts are considered.
- Public interest in the environmental assessment board hearings of our demand/supply plan.

Non-EA Group (question C-12)

The type of public and interest group involvement in an EA produced a wide range of responses. Public hearings [18%] were the most often mentioned, followed by public forums [14%], survey of public opinion [9%], no public involvement [14%], other forms of participation [27%], and the rest gave no response [18%]. Other forms of public involvement mentioned included regulatory agencies, working directly with a variety of organizations in establishing DSM plans and programs both formally and informally.

Analysis

Both groups indicate public hearings as the most common form of public involvement in the planning process. Non-EA respondents gave a range of other venues. This may only be an indication of the larger size of the Non-EA respondent sample and an indication they have not fully considered the implications of these public consultation options.

2.1.8 Costs of EA: (questions B-10, C-7)

EA Group (question B-10)

There was agreement and disagreement about how EAs would affect the costs of DSM programs.

- None.
- The costs can be so great that they can make a program lose its cost-effectiveness at the companies avoided cost of generation.
- No major impacts.

- It would increase costs due to greater staff time and need for consultant studies.

Non-EA Group (question C-7)

Some Non-EA respondents indicated that it was too early to determine how an EA would influence the costs of DSM programs. Others had different opinions:

- Costs will not be influenced by results.
- Would add to the overhead.
- Depends on the outcome of the EA.
- An EA could help reduce the effective costs of a DSM program by showing the environmental savings.
- If the program costs were offset by a tax on users of the environment then costs would decrease for the utility. However, the type of tax may determine whether the costs savings are enjoyed by all customers or only participants in DSM programs.

Analysis

The design and operation of DSM programs in several cases was felt to be affected by the use of EAs. In terms of design more time and costs were incurred in developing programs. The added time delayed implementation and the added costs raised the administrative costs of programs and therefore diminished the overall cost-effectiveness of those programs. In terms of the operation of DSM programs it appears that in some cases where mitigation measures are required added costs and time are required to perform DSM measures. The added costs can again lead to reducing the cost-effectiveness of DSM programs.

2.1.9 Life-cycle analysis: (questions B-11,12,13, C-13, 14)

EA Group (question B-11)

Respondents were asked whether they perform life cycle analysis. Most indicated they do not [67%] while the remainder either said yes [22%] or gave no response [11%]. Comments were added to qualify the two affirmative answers.

- To a degree but not for all end-use technologies.
- Yes, on some programs.

Non-EA Group (question C-13)

Non-EA respondents indicated that they had a mixed opinion about whether they would perform life-cycle analysis. Similar numbers indicated yes [31%] and no [38%]. The rest indicating other [19%] or giving no response [13%]. One respondent noted they would do life cycle analysis if they did an EA.

EA Group (question B-12)

A similar question followed, however in this case they were asked if they required life cycle analysis from the supplier of a product. All answers were negative [67%] while the remainder gave no response [33%].

Non-EA Group (question C-14)

Non-EA respondents had a variety of opinions as to whether they would require manufacturers of DSM products to perform life cycle analyses. Equal numbers indicated yes [31%] and no [31%] to this question. Several indicated other [19%] or gave no response [19%].

Analysis

This form of analysis is well suited to looking at the impacts of an activity or the use of a technology in a detailed and thorough manner. The Non-EA respondents also indicated an interest in using this form of analysis. The large level of uncertainty suggests that many have not formed an opinion about its use. Since utilities are promoting the use of manufacturers energy efficient products it is somewhat odd that none of the utilities suggested that manufacturers be the ones responsible for performing life cycle analysis of their products.

2.2.0 Performance of Future EAs: (question B-13)

EA Group (question B-13)

The last general question asked respondents what further environmental assessment work they intended to do on their DSM programs.

- None in the near future.
- Unknown

- Life cycle analysis is expected to be extended gradually to more programs.

Non-EA Group

No equivalent question exists.

2.2.1 Criteria to Determine Mitigation Need: EA Group (question B-14)

The first question in the mitigation section of the questionnaire asked what criteria were used to determine whether an environmental impact warrants mitigation. All choices were identified. In order of decreasing response: impact significance [26%], impact magnitude [21%], impact area [16%], impact probability [16%], and other [11%]. A few gave no response [11%]. The selection of other included the following comments:

- Superfund liability.
- Programs are designed with mitigation measures built in.

2.2.2 Mitigation Needs Identified: EA Group (question B-15)

Respondents were asked if their EAs identified any mitigation requirements for their DSM programs (question B-15(a)). Nearly an equal number said yes [33%] and no [44%], with the remainder giving no response [22%]. They were also asked to describe any mitigation measures (question B-15(b)).

- Recycling/disposal of ballasts containing PCBs.

- Recycling/disposal of lamps containing mercury.
- Incineration of CFC-11 foam [probably contained in refrigerators].
- Recycling refrigerators required that CFCs etc. be removed and disposed of. The program was designed to permit this, and the costs of the program included it.
- In our Fridge Buy-Back program several mitigation measures were taken
  - CFCs captured and recycled.
  - capacitors collected and ones with PCBs stored.
  - fridge hulk - metal recycled.

A follow up question sought to determine how the form of mitigation was determined (question 15(c)).

- Environmental regulations require mitigation.
- Investigation of available disposal techniques and infrastructure.
- Independent analysis or interactive utility correspondence.

A final related question asked respondents to place the identification of mitigation within the assessment process (question 15(d)). The scoping stage was the most common answer [36%]. This was followed by the significance assessment stage [18%], and identification after the assessment [18%], several gave no response to this question [27%].

2.2.3 Mitigation Responsibility: EA Group (questions B-16,17,18)

The last two questions in the mitigation section sought to determine who should be responsible for implementing mitigation measures (question B-16), funding these measures (question B-17), and finally monitoring them (question B-18). Responsibility for implementing mitigation measures was placed mainly with the utility (Figure C3). Government and industry were also mentioned equal times. One respondent felt all were responsible.

- It depends on the nature of your DSM programs and how they are implemented. Sometimes the customer could be considered responsible.

Responsibility for funding of mitigation measures had a similar response. The utility was considered responsible most often [46%], followed by government [15%], industry [15%], and several giving no response [23%]. One respondent noted all are responsible (including the customer) depending upon the nature of the program. The responsibility for monitoring of mitigation produced similar results to the previous two questions. The utility was identified most often as responsible for monitoring [50%] followed by government [17%], industry [8%], other [8%], and no response by two [17%].

- The utility would be involved in all cases - to some degree.

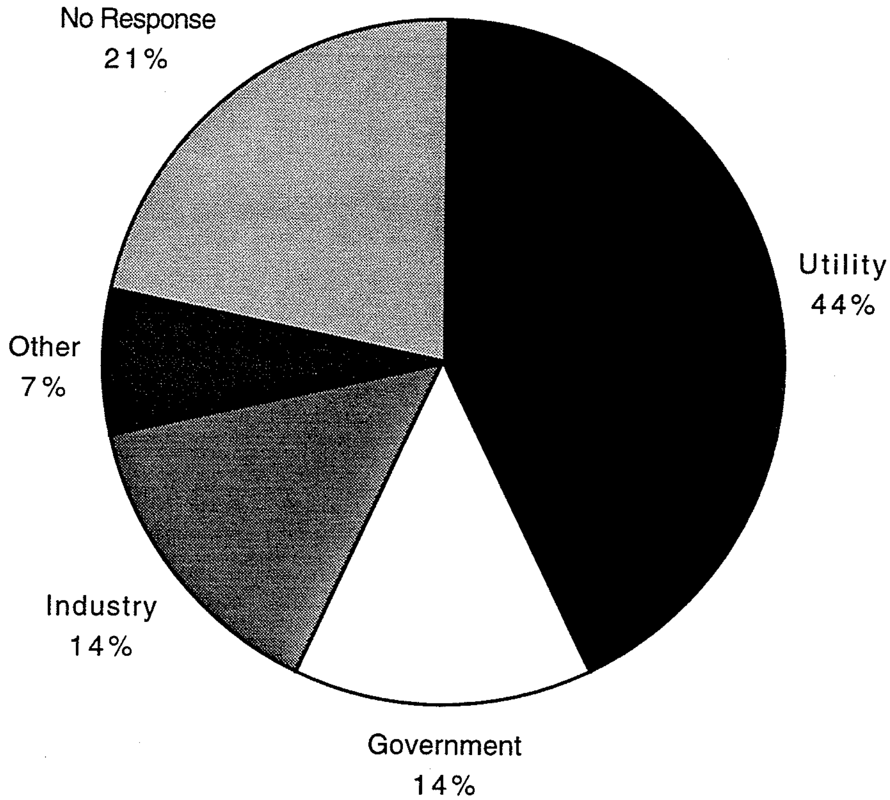

Figure C3 Responsibility for implementing mitigation
EA Group (Question B-16)

2.2.4 Mitigation Timing: Non-EA Group (question C-25)

There was little preference regarding when mitigation requirements would be identified within the EA process. An almost equal number indicated the scoping stage, the significance assessment stage, and after the assessment (Figure C4).

2.2.5 Criteria to Determine Mitigation Need: Non-EA Group (question C-26)

The criteria used to determine whether an impact warrants mitigation were varied. However Impact Significance, Area, and Magnitude were the most preferred criteria (Figure C5). Several noted that all to some degree would be used. While another suggested it would depend on the impact.

2.2.6 Mitigation Responsibility: Non-EA Group (questions C-27, C-28, C-29)

Responsibility for the implementation of mitigation procedures was felt to rest with the utility, government, and industry, in that order (question C-27). A few respondents noted it would be a combination of these. Another indicated that it was not clear who would be responsible (Figure C6). Respondents indicated that they felt a similar way regarding who should fund mitigation (question C-28). The utility and government being mentioned the most often (Figure C7).

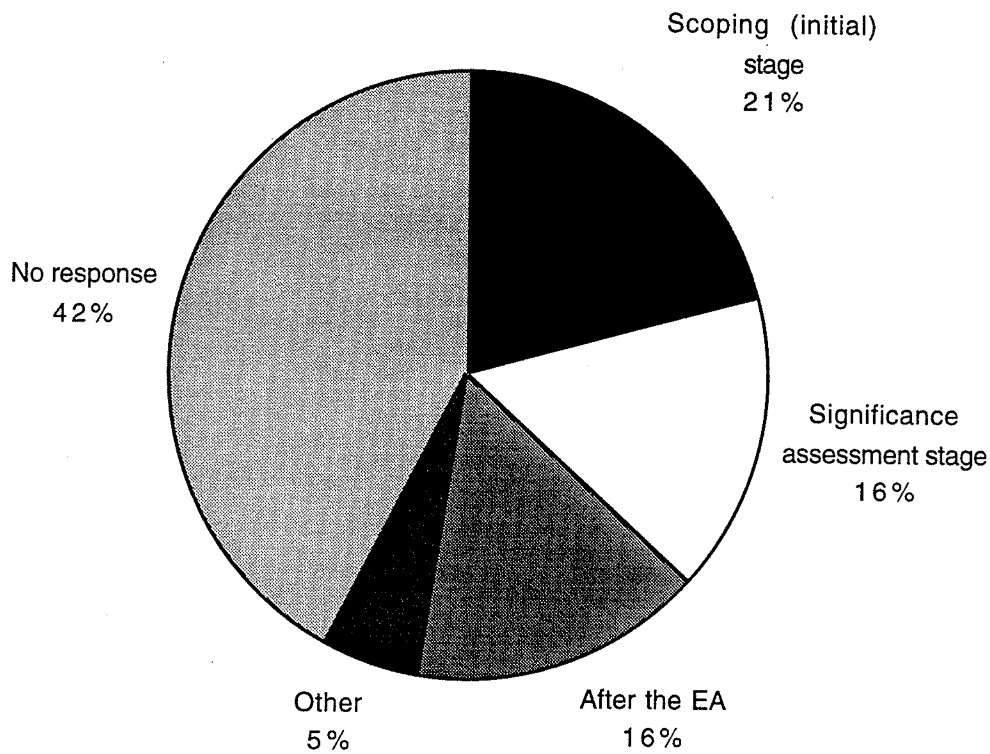

Figure C4 Timing of mitigation identification
Non-EA Group (Question C-25)

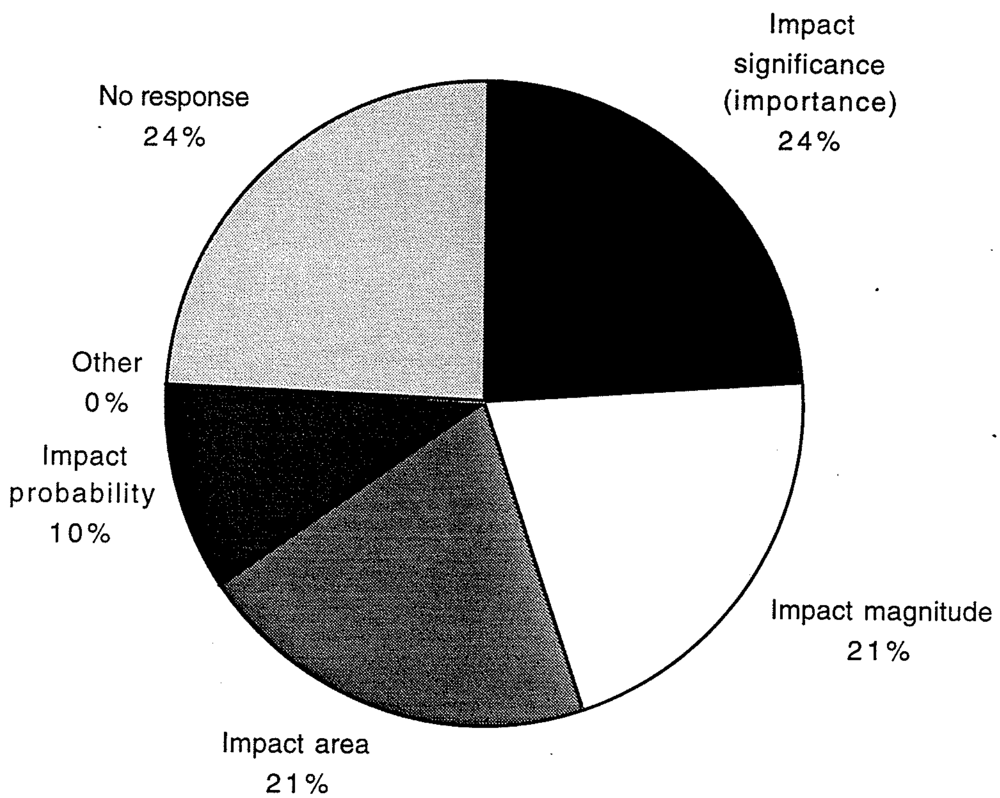

Figure C5 Criteria to determine mitigation need
Non-EA Group (Question C-26)

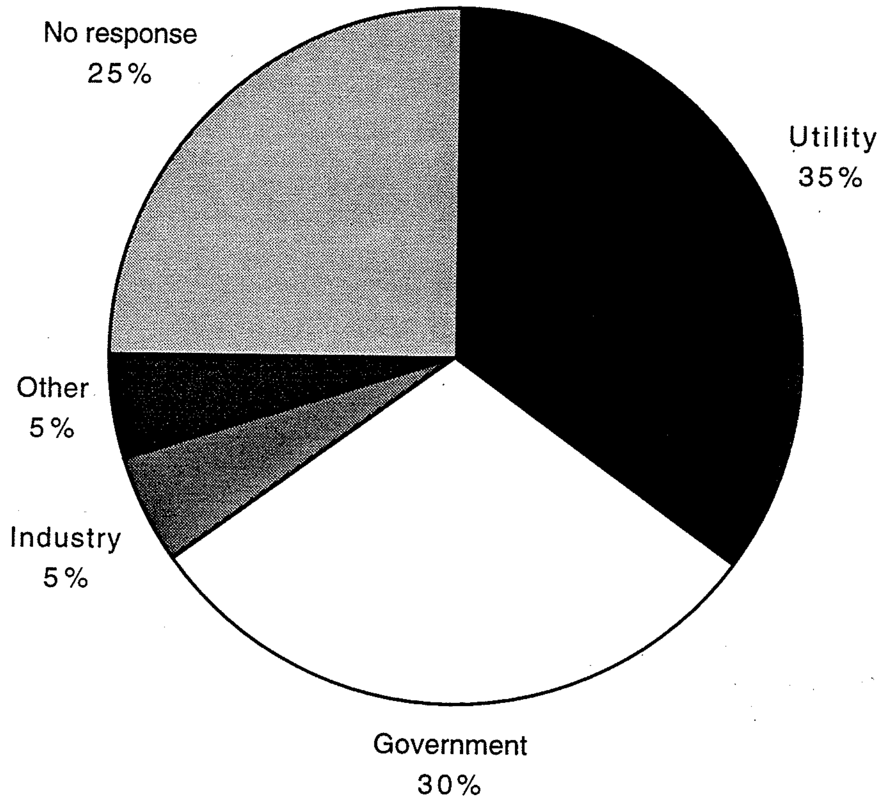

Figure C6 Responsibility for implementing mitigation
Non-EA Group (Question C-27)

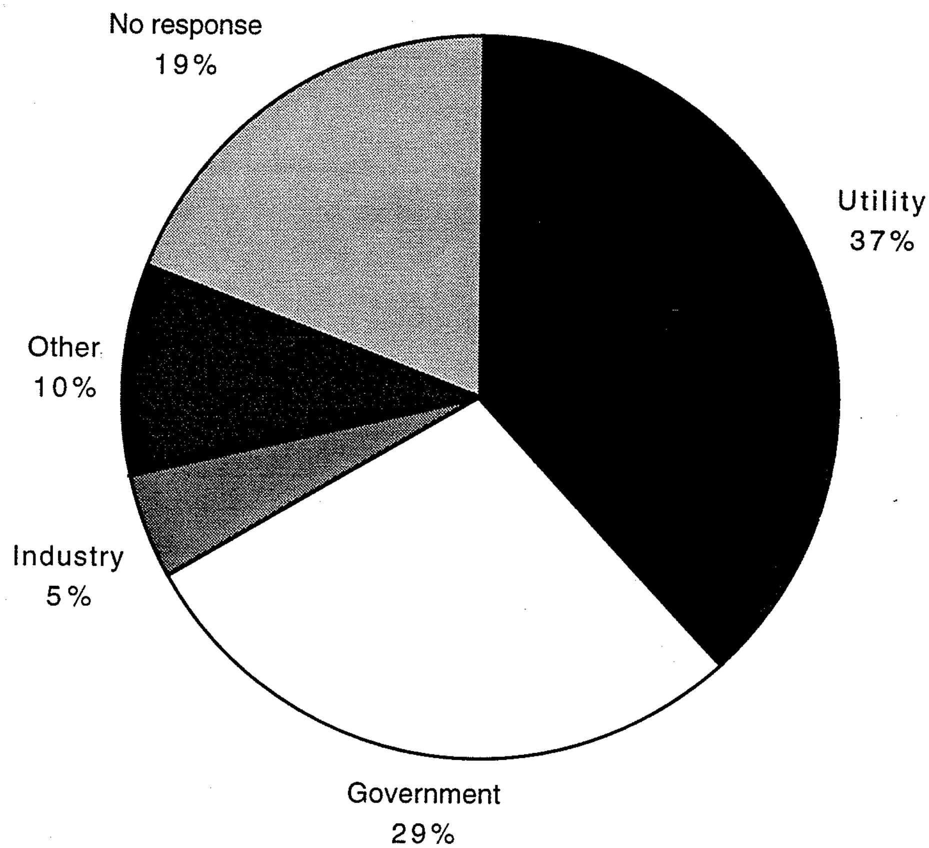

Figure C7 Responsibility for mitigation funding
Non-EA Group (Question C-28)

Several suggested other answers:

- It would depend on the type of program & type of measures installed.
- Each sector would pay per unit of pollution reduced.

Responsibility for monitoring of mitigation had similar responses (question C-29). Again a respondent noted that responsibility would depend upon the type of program and type of measures installed. Another indicated that each sector would monitor its own pollution.

Analysis

Mitigation measures all dealt with waste issues. In some cases these were hazardous wastes, depending on the quantities involved, such as PCBs and mercury containing lamps and in other cases these were wastes that were felt to require environmentally sound disposal, these included CFC-11 foam, and scrap metal from fridges.

Responsibility for mitigation in terms of implementation, funding, and monitoring was indicated as resting mainly with utilities. However, a more appropriate answer may have came from two comments mentioned above: that it depended upon the nature and implementation of the DSM programs and that it is possible that all could be responsible. Non-EA respondents echoed these preferences and opinions.

2.2.7 Spatial Constraints:

EA Group (questions B-19, B-20)

Respondents were asked numerous questions about environmental impact identification, prediction, and evaluation. The first question asked what spatial constraints were placed upon the identification, prediction and evaluation of environmental impacts (question B-19). Respondents indicated the program area [18%], province/state [27%], country [18%], other [9%], and the remainder gave no response [27%]. No respondent indicated the continent as their choice for a spatial constraint. One respondent noted:

- It differs in each case. Tends to be provincial boundaries.

Few reasons were given for the choices made regarding spatial constraints (question B-20).

- State and federal regulations/standards and or requirements.

Non-EA Group (questions C-15, C-16)

There were several different opinions about the spatial constraints that should be placed on the identification, prediction, and evaluation of environmental impacts (question C-15). The province or state [28%] was followed by the program area [22%], while other [17%] included some choices that were not available in the questionnaire [NR=33%].

- Resource options are evaluated on a societal basis, leaving this flexible.
- Global, Program Area, Province or State.

A related question sought to find out how these constraints would be determined (question C-16). Responses included the utility service area, jurisdiction of provincial regulatory and appeals commission. One respondent suggested that the constraint would depend upon the impact being considered.

- Town districts: NOx, SOx, and particulates, and noise.
- Region: NOx, SOx contents in air and soil.
- Global: Emission of greenhouse gases and ozone destroying gases.

Analysis

Respondents gave a variety of responses to this question; several noted that it depended upon the situation. This is likely the most appropriate answer. Another respondent suggested similar flexibility in defining spatial constraints; study boundaries would be dependent upon the type of impact being considered.

2.2.8 Impact Identification

EA Group (questions B-21, B-22)

A series of questions were asked specifically about impact identification. The first of these determined that the identification of affected groups of people was not part of utility EA processes (question B-21(a)). Very few [22%] indicated that affected groups were identified, while most respondents said none were identified [33%], the remainder failed to respond [44%].

The next question attempted to determine the method used to identify these groups (question B-22). Since few indicated that groups were identified it is not surprising that many gave no response to this question [78%]. Those that did noted self-identification [11%] and other [11%] methods.

2.2.9 Environmental Components

EA Group (questions B-23, 24, 25)

Respondents indicated that publicly valued environmental components (PVECs) were identified in a small number of cases [11%] while a larger number did not identify groups [44%] or gave no response [44%] (question B-23(a)). There was no response to the follow-up question asking what were the most important PVECs (question B-23(b)). One respondent noted that usually utility staff, and in some cases universities identified the PVECs (question B-23(c)). Respondents who identified PVECs were asked to indicate if desired quality standards were assigned to the PVECs question B-23(d)). No responses were obtained.

Respondents were asked whether they had identified scientifically valued environmental components (SVECs) (question B-24). There was too limited a response to this question to indicate any preferences [NR=56%]. A similarly poor response [NR=75%] was obtained for the next question, that sought to find out what degree of environmental impacts were considered by the assessments (question B-25).

2.3.0 Impact Identification Techniques

EA Group (question B-26)

Determining techniques used to identify impacts received a poor response. One respondent commented that these were not used at this stage. He may be referring to the present stage in the development of the assessment of DSM programs. In that case his comment may explain the poor response to this question.

Non-EA Group (question C-17)

Non-EA respondents were asked only one question regarding the identification of impacts. Respondents indicated that they would use various techniques when identifying impacts. All except ad hoc was mentioned with checklists [18%] and other [18%] chosen most often. Response was poor for this question [NR=47%] and preferences are difficult to determine.

Analysis:

The identification of SVECs and PVECs appears to be a process that few respondents perform. This may be a characteristic of a problem or issues oriented assessment process that does not require a dedicated technique for the identification of impacts. The EA of DSM measures requires the identification of a limited number of impacts compared to the EA of other projects or activities.

2.3.1 Impact Prediction - Probability and Uncertainty

EA Group (questions B-27, B-28)

The questionnaire contained a section that sought information on the impact prediction process of assessments. Respondents were asked whether probability values were assigned to impact predictions (question B-27). Most failed to respond [56%], those that did indicated none [44%] had been assigned. A follow-up question asked whether impact predictions specified the uncertainty and level of confidence of these predictions (question B-28). Again, most failed to respond [56%] and the rest [44%] noted that none had been specified.

2.3.2 Impact Prediction - Type of Measurement

EA Group (question B-29)

Predictions can be qualitative and quantitative, however if quantitative it is important to know the type of measurement used. Respondents were asked what type of measurement they used. Answers to this question were limited [NR=89%] making it difficult to draw any conclusions. However, one respondent commented that the type of measurement was not relevant since their assessment was qualitative in nature.

2.3.3 Impact Prediction - Techniques

EA Group (question B-30)

Respondents were asked to indicate what techniques they used to predict impacts. They answered equally for ad hoc committee [17%], computer modelling [17%], and professional judgement [17%]. No one choose delphi technique and many failed to respond to the question [50%].

Non-EA Group (question C-18)

Only one question asked Non-EA respondents about the prediction of impacts. Respondents indicated that various techniques would be used in predicting impacts (question C-18). Professional judgement [25%] was chosen most often followed by computer modelling [20%], other [15%], ad hoc committee [5%], and several giving no response [35%].

Analysis

Both responding groups noted that all techniques would be used to predict impacts, with the exception of the Delphi technique.

2.3.4 Impact Significance

EA Group (questions B-31,32,33)

The next group of questions focussed on determining impact significance. Respondents indicated that the criteria they used to assess impact significance was both changes to environmental components in relation to quality standards [33%] and in relation to baseline conditions [25%] (question B-31). A number of respondents [42%] failed to answer this question. One respondent commented that they used both, with emphasis placed on quality standards.

The specification of threshold values for the environmental components of a significance assessment was done by fewer than a quarter of respondents [22%] (question B-32a). A large number failed to respond to this question [NR=56%]. Respondents were asked how they defined these threshold values and indicated regulatory agencies such as the U.S. Environmental Protection Agency (EPA) and legislation such as the U.S. "Clean Air Act" (question B-32b).

Determining risk of damage to environmental components by respondents (question B-33(a)) received few responses [NR=56%] and preferences are difficult to determine. One respondent commented that this is not usually done at the utility level, it was more likely to be done by the EPA.

Non-EA Group

No equivalent question was asked of Non-EA respondents.

2.3.5 Impact Evaluation - General

EA Group (questions B-34, 35,36,37)

Impact evaluation was the subject of a series of questions. There was little consensus as to whether or not utility impact evaluation methods were easy for non-experts to understand (question B-34). Two respondents [22%] indicated that they used a common measuring unit (question B-35(a)), although response to this question was limited [NR=44%]. There was virtually no indication by respondents regarding the type of measurement used in their evaluations [NR=89%] (question B-36). No respondents indicated they used a weighting scheme for evaluating environmental impacts and environmental components (question B-37(a)). Although many failed to respond to this question [56%].

2.3.6 Evaluation of Alternatives

EA Group (question B-38)

The consideration of alternatives to a proposed program is an integral part of many types of EA, however, few respondents [11%: NR=56%] were able to indicate whether these were considered (question B-38(a)). Those responding that they did consider alternatives were then asked whether the "no action alternative" was considered (question B-38(b)). The response to this question cannot be used to indicate any preferences since so few responded to the first question. One respondent noted in response to the first question (question B-38(a)):

- It compares environmental conditions with and without the DSM measure. Without the measure, the energy will come from supply side resources.

Non-EA Group (question C-19)

Non-EA respondents were not asked about how difficult their method was for the non-expert to understand, whether they used a common measuring unit, the type of measurement, or would weight their impacts or environmental components.

The consideration of alternatives was anticipated by over one third of respondents [38%] to be a part of their EA process in the future (question C-19a). While fewer indicated alternatives would not be a part of their EA process [13%] with many giving no response at all [50%]. One respondent commented that alternatives would be considered provided they had similar impact and similar cost. Another noted that the consideration of alternatives would mirror their present DSM planning which considers many alternatives. In a further related question (question C-19b) all respondents [100%] who answered that they would consider alternatives indicated the no-action alternative would be included in their EA.

2.3.7 Impact Evaluation - Techniques and Methods

EA Group (questions B-39, 40, 41)

The use of a single measure to consolidate the impacts of each alternative was not indicated by any of the respondents (question B-39) although most [67%] failed to respond to this question. Nor did any of the respondents employ sensitivity analysis of variables in their assessment (question B-40) and again most [67%] did not respond.

Although environmental assessment uses a number of different techniques to evaluate impacts, respondents indicated that the simplest techniques were most used (question B-41). Ad hoc committees [18%], cost-benefit analyses [18%], and tabular comparison of alternatives [9%] were all indicated as techniques that were used, while most failed to respond [55%].

Non-EA Group (question C-20)

Non-EA respondents were not asked whether a single measure was used to consolidate impacts or whether sensitivity analysis was performed. Techniques that respondents considered useful in evaluating impacts were varied with emphasis placed on cost-benefit analysis (Figure C8).

Analysis

A few conclusions can be drawn from the responses in the evaluation questions. The Non-EA respondents were considerably more interested in considering alternatives within their EA process than the EA respondents. This suggests that present DSM EAs are not very involved in the planning and decision making process, and are instead used as a means of investigating impacts as an adjunct to the process.

It also appears that respondents are using the simplest techniques (ad hoc committees and tabular comparison of alternatives) as well as those most often used by economists (cost-benefit analysis) to perform evaluations. Non-EA respondents indicated a preference for cost-benefit analysis, although other techniques were also suggested. Some of the other more sophisticated techniques of evaluation such as the use of

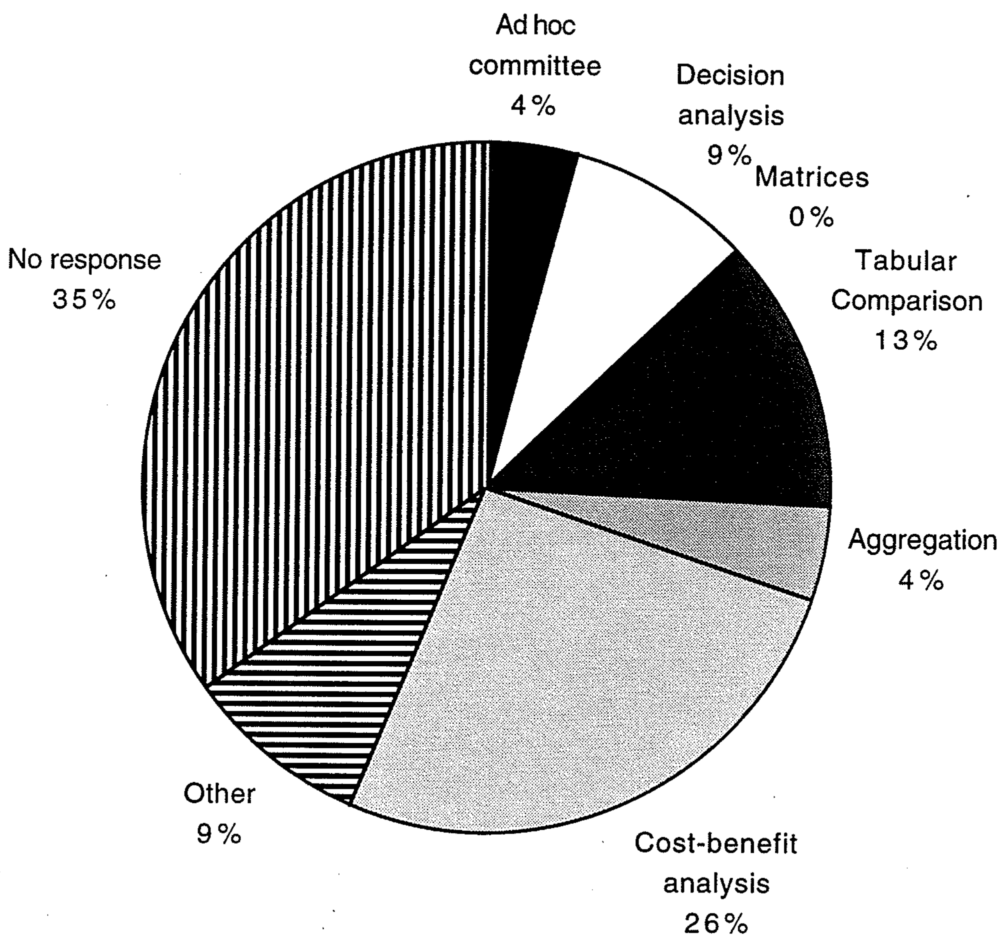

Figure C8 Impact evaluation techniques - alternatives
Non-EA Group (Question C-20)

weights, sensitivity analysis of variables, and a single measure were not being used. One of the most basic parts of environmental assessment, the consideration of alternatives would not appear to be used by those performing EAs.

2.3.8 Monitoring

EA Group (questions B-42,43,44,45)

Monitoring was the subject of several questions within the questionnaire. Respondents indicated that most [56%: NR=22%] would be involved in monitoring of DSM programs (question B-42(a)). Those conducting monitoring indicated varied reasons for doing so (question B-42(b)). These included determining regulatory compliance [15%], mitigation effectiveness [15%], prediction accuracy [23%], in response to public demands [23%], and less often hypothesis testing [8%], only a few giving no response [15%]. It was felt by equal numbers [22%] that the public would and would not be involved in monitoring although many gave no response [44%] (question B-43). The role of the public in these two cases was explained:

- Customers will allow us to meter their equipment.
- Participation in surveys and focus groups.

The length of monitoring programs was variable and ranged from being a continuous process to several weeks before a retrofit to several weeks after the retrofit and even a year or two later (question B-44). Responsibility for monitoring was felt by most respondents to rest with the utility [45%] and less often with the federal government [9%], the state/provincial government [9%]. Several gave no response [36%] to this question (question B-45).

Non-EA Group (questions C-21,22,23,24)

Monitoring of the environmental impacts of the DSM programs was anticipated by most respondents in the future (question C-21(a)). Respondents justified monitoring for various reasons, the most common being determining regulatory compliance, prediction accuracy, and hypothesis testing (Figure C9).

Public involvement in monitoring was given a mixed response with many suggesting the public would not be involved [36%] with fewer involving the public [29%] (question C-22(a)), and the rest indicating no response [36%]. According to those who preferred a role for the public it would include surveys of public opinion as well as the installation of monitoring equipment (question C-22(b)). Respondents noted that the duration of monitoring was difficult to determine (question C-23).

- It would depend upon what we were monitoring and what we were trying to determine.

Respondents felt that the responsibility for monitoring would most often rest with the utility (question C-24) (Figure C10).

Analysis

In some cases the responses to the monitoring questions appeared to be misunderstood by the respondents. It appears that monitoring for environmental impacts was confused with monitoring the performance of DSM programs in a few cases. The emphasis on

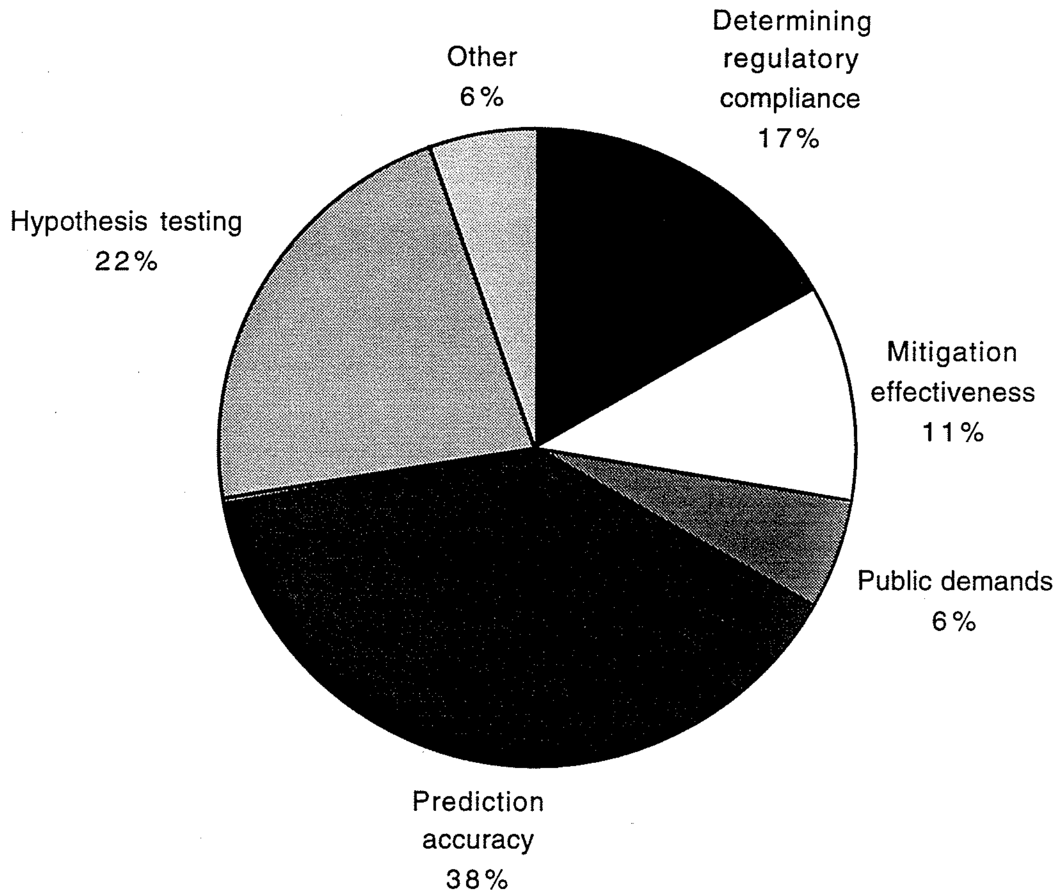

Figure C9 Reasons for performing monitoring
Non-EA Group (Question C-21b)

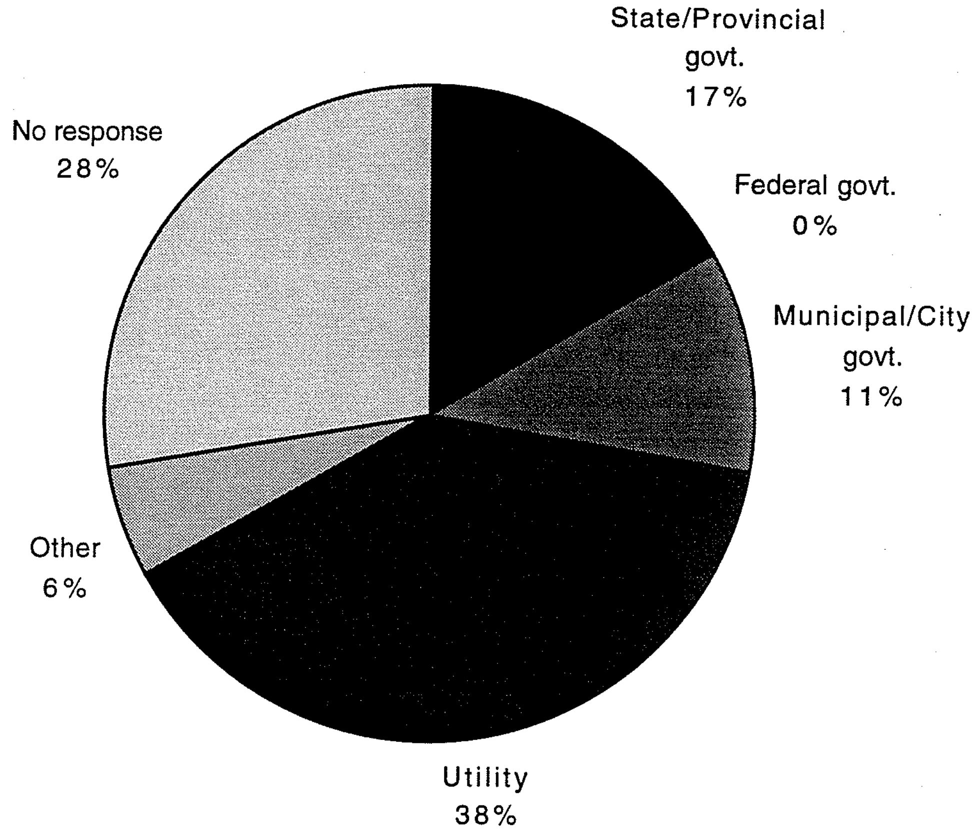

Figure C10 Responsibility for monitoring
Non-EA Group (Question C-24)

the utilities role in monitoring is consistent with the preference for its role in mitigation implementation and funding.

3.0 COMPLETE SURVEY RESPONSES AND SURVEY SAMPLE

The following section provides several types of information related to the survey and questionnaire. First it gives a complete listing of all answers to the questionnaire. This includes answers and comments to the multiple-choice questions, additional comments given in response to the multiple-choice questions, as well as answers to non multiple-choice questions. Comments following multiple choice questions are usually followed by the following bracket notation "[4-3]" which relates the text of a comment to the question (first digit - ie. #4) to the related multiple choice answer(s) (all digits following first - ie. answer #3).

The survey results are displayed within a copy of the questionnaire. Each survey question is followed by the responses to that question. Finally, at the very end is a collection of comments that were given by respondents but which were not written on the questionnaire.

In a few cases recipients filled in an additional choice that did not exists for the multiple-choice questions. When a long answer form was given for a multiple-choice question and no multiple-choice answer was selected then "other" was selected for the recipient and the long-answer noted. When a multiple-choice question category has an italicized *name* this indicates this category was created after the survey's responses were tabulated. If a respondent indicated "all of the above" or "a combination of the above" then all were chosen *for* the recipient and the long-answer noted. The tabulation of the multiple-choice responses uses the abbreviation "NR" for respondents that failed to answer the question.

Utility Questionnaire and Questionnaire Results

Part A

1. Have environmental assessments (EA) of your demand side management (DSM) programs been performed?

1. Yes. 2. No. *3. Other*

	Questions		
	1	2	3
Can.	3	8	
U.S.	3	6	
Other	2	5	1
Total	8	19	1
% Total	29%	68%	5%

- I'm not sure what you mean by an E.A.
- What we premiss (sic) our programs upon, is the fact that reduced consumption results in reduced emissions, land use, etc.
- KWH savings can be translated into reduced emissions (on a KG. basis, say) of CO_2, NO_x , ETC, but this is not done on a regular basis.
- Therefore, I have answered "No".

If yes, continue with part B, otherwise skip to part C.

Part B:

General questions:

1. Please provide a brief description of the scope of the assessment and the level of detail of the analysis.

Emission level comparisons of resource options have been identified and total emission levels for plans with a different mix of supply-side and demand-side resources have been quantified.
Environmental externalities are part and parcel of the DSM programs.
The env. impacts of implementing a variety of DSM measures are continuously reviewed and assessed in as for that our company meets all state and federal regulations. In addition, measures are taken to go beyond the requirements in order to maintain the moral obligations that we have to our customers in as far as ensuring that proper disposal of potential hazardous waste is strongly encouraged. In addition, there are environmental benefits to the society that we can take credit for by offering DSM programs that encourage our customers to use electricity more efficiently.

The assessment is a general qualitative evaluation in most cases, although it may involve some quantitative analysis as well in the case of load growth programs. For example, in refrigerator buyback programs, the question of dealing with the CFC's had to be addressed. For electrotechnology assessments load may increase for [our utility], and this may increase [our utility's] emissions. However, the emissions of the customer using the technology may be lowered to more than off-set this.
A complete report is attached of "Supply Side Environmental Effects..." 1. Residential Refrigeration program development work included a thorough investigation of environmental regulation trends, disposal techniques, and available infrastructure. 2. A...community Retrofit Program had an investigation of the environmental implications of all retrofit measures. 3. Investigations were carried out on environmental regulations and trends affecting energy management in all sectors. [4. No complete environmental assessment has been done on our utilities DSM programs.]
In the Netherlands all energy-distribution-companies participate in an 'Environmental Action Programme'. The goal of the EAP is energy-saving at the demand side, energy production through natural sources (wind, water and solar energy) and co-generation of electric and thermal energy.
[The Environmental Action Plan of the energy distribution sector in the Netherlands 1991] ...is in action now and yearly evaluations have been made for total CO_2 - reduction...
[Our utility] has instituted a general procedure for addressing the environment impact due to the production, utilization, and disposition of equipment and material used by or replaced through a energy efficiency program. With that procedure we make sure that at the planning stage, or at the conception & development level, we can identify the program that can have undesirableimpacts and that we implement mitigation or attenuation measure[s] when needed.

2. Please give the reasons assessments were performed.

To assess the impact of DSM programs on emission levels.
This may have been done through our subsidiaries.
Assessments are performed in order to try and identify the true costs of implementing our programs to the utility and to society. In order to determine whether or not a program is cost-effective, we need to consider all the environmental impacts, whether they are negative or positive.
Environmental impacts are assessed for all energy resource options as a standard procedure.
1. Old fridges were purchased from customers and disposed of in an environmentally friendly manner to gain added buy-in to the program. 2. In encouraging weathersealing of building, [the utility] wanted to ensure that it wouldn't result in health hazards for occupants. 3. Programmers must be aware of regulations to ensure compliance and must be aware of trends in regulations for EM planning purposes.
The programme is an voluntary action to meet the goals of the governmental policy on environmental issues in the Netherlands.

Based upon the environmental targets of the government the distribution sector took... this initiative [in the Netherlands].
[Our utility has an environmental policy with the following goals:] • to affirm [the utility's] responsibility for protecting and enhancing the environmental resources it uses or affects in the course of its activities; • to provide a framework of guidelines and mechanisms that enable managers to translate this responsibility into action. In order to respect that Policy, the Energy Efficiency branch had to adopt a procedure that put in place the necessary mechanisms.

3. Who performed the environmental assessment?

1. Utility Environmental Dept.
2. Utility DSM Dept.
3. Outside agency, (please specify)
4. Outside consultant, (please specify)
5. Other, (please specify)

	Questions					
	1	2	3	4	5	NR
Can.		2		1	1	
U.S.	1	2			1	
Other		1		1	1	
Total	1	5	0	2	3	
% Total	9%	45%	0%	18%	27%	0%

Barakat and Chamberlin "Electro-technologies for env. improvement.." Sarah Rang - Env. regulations for resource programs. Scanada consultants - Indoor air quality in multiple residences.... [3-2,4]
Utility planning dept. [3-5]
Resource Planning Dept. [3-5]
The assessment is a combined action of the energy distribution companies with the support of McKinsey consultants. [3-4]

4. How have the results of the environmental assessment influenced the design of your DSM program?

None
It makes some of the programs justified.
We try to offer programs that are environmentally beneficial to our customers (or society in general). If the program must incurr greater costs to account for additional costs due to disposal, regulations, standards, etc. Then the program may become Not cost-effective. Thus, the program(s) would either be eliminated or redesigned for the next program year.
Programs are designed to minimize environmental impacts as much as possible within reason.
It resulted in additional training of contractors in some cases and in others changed requirements to be met for incentives.
The EAP was designed to reduce the emission of CO_2, SO_2 and NO_x by means of energy saving.

Up to now, we have not identified attenuation or mitigation measures...needed to respect the environment.

5. Please describe how the environmental assessment results influenced the time required to implement your DSM programs.

None
Part of the annual process for commission approval.
In one particular program where we had to investigate the proper disposal of CFC-11 foam, it has delayed the program by one year.
No impact on timing of DSM to date.
It adds to the time required for developing the programs and in some cases to the time required for energy efficiency upgrades.
The required time was influenced by the governmental environmental policy to solve the environmental problems within the time-scale of this generation (WHO/Brundtland - [report])
There were no delay[s] in implementation of DSM programs so far because of the environmental assessment

6. At what point within the utility's planning & decision making process was the assessment performed?

1. Power resource plan
2. Overall DSM program plan
3. Individual DSM program plan
4. Other, (please specify)

	Questions				
Region	1	2	3	4	NR
Can.	1	2	3		
U.S.	1	1	1	1	
Other		1	1	1	
Total	2	4	5	2	0
% Total	15%	31%	38%	15%	0%

Done for each program. [6-4]
At points when federal concerns are being voiced by other utilities besides ourselves. Usually, federal regulations [U.S.] are in the making which prompt further assessment of the issue at hand.[6-2,3]
We do not see our environmental action plan [Netherlands] as a DSM - program but only as a conservation and CO_2- reduction plan. Although it has some DSM aspects.[6-4]
Concerning point 2, when a measure can generate a health or environment problem, that measure is normaly studied with the correction needed for its implementation.[6-2,3]

7. As a DSM plan progresses from the Power Resource plan of the utility to the development of detailed individual programs, did you perform different levels of environmental analysis on these DSM programs (eg. increasing complexity of analysis as a DSM program moves towards implementation)?

1. Yes
2. No
3. Other, (please specify)

	Questions			
Region	1	2	3	NR
Can.		2	1	
U.S.		1	1	1
Other	1	1	1	1
Total	1	4	3	2
% Total	10%	40%	30%	20%

It depends. Sometimes the environmental assessment is not made or cannot be resolved until the program has reached a more majore stage - and an understanding of the technology is achieved through experience. [7-3]
Individual programs are designed first and then submitted as possible energy resource options in the Integrated Resource Plan. The intitial designs recognize some environmental aspects. These may be refined by the Integrated Resource Plan and/or the final implementation plan. [7-2]
At every step of the development of the Energy Efficiency Plan we have to focus on different level of analyses and therefore, take into account different considerations.[7-3]

8. Can you give reasons for the approach adopted in 7?

DSM programs have only moved to the pilot program stage. Implementation is still years away. [7-2]
Sometimes, because of Superfund liability issues, we must proceed with caution on any environmental issue or policy. [7-3]
Lack of resources. [7-2]
Individual program may not pass Total Resource Cost test and hence would be rejected. The initial program design has to be reasonably complete, but not designed to the implementation stage. [7-2]
To specify environmental impact of choosen options or projects. [7-1]

9. What is the degree of public/interest group participation in DSM environmental assessments?

1. None
2. Survey of public opinion.
3. Public forums.
4. Public hearings
5. Other, (please specify)

	Questions					
Region	1	2	3	4	5	NR
Can.	1			2		
U.S.				2	1	1
Other		1			2	
Total	1	1	0	4	3	1
% Total	10%	10%	0%	40%	30%	10%

Special advocacy groups representing the public.[9-4,5]
There are regulatory hearings reviewing the Integrated Resource Plan and associated DSM. The focus is not on environmental assessment in the same way that a EA might be conducted for a supply side option, but environmental impacts are considered. [9-4]
Interest has been displayed mainly in the Environmental Assessment Board Hearing [on our demand/supply plan]. [9-4]
Information and influencing the public to promote energy-saving (public actions, campaigns) [9-5]
[Public hearings] with specific consumer groups, [government, parliament], local authorities. [9-5]

10. Please describe how the environmental assessment results influenced the costs of your DSM program.

None
The costs can be so great that they can make a program not cost-effective to implement at the company's avoided costs of producing capacity.
No major impacts.
Increases costs because of staff time and consultant studies.
The costs of the programme are a result of the environmental policy-goals.
It has not had a major impact so far.

11. Does your utility perform life cycle analysis?

1. Yes.

2. No.

	Questions		
Region	1	2	NR
Can.	1	2	
U.S.	1	1	1
Other		3	
Total	2	6	1
% Total	22%	67%	11%

To a degree - not for all end-use technologies. [11-1]
On some programs. [11-1]
- Some studies have been done. - When options are chosen in some cases the life cycle is looked upon. [11-2]

12. Does your utility require life cycle analysis of DSM products by the supplier of the product?

1. Yes. 2. No.

	Questions		
Region	1	2	NR
Can.		3	
U.S.		2	1
Other		1	2
Total	0	6	3
% Total	0%	67%	33%

Unknown

13. Please describe any further environmental assessment work you intend to do on you DSM programs.

None in the near future.
Unknown
Life cycle analysis is expected to be extended to more programs - gradually.
Specification of emission-reduction as a result of the programme and projects.

Mitigation:

14. What criteria determines whether an environmental impact warrants mitigation?

1. Impact significance (importance).
2. Impact magnitude.
3. Impact area (Public safety, wildlife, etc.)
4. Impact probability.
5. Other, (please specify)

	Questions					
Region	1	2	3	4	5	NR
Can.	2	1	1	1	1	
U.S.	2	2	1	1	1	1
Other	1	1	1	1		1
Total	5	4	3	3	2	2
% Total	26%	21%	16%	16%	11%	11%

Superfund liability. [14-1,2,5]
Programs are designed with mitigation measures built in. [14-5]
All of these criteria. The problem still lies in identifying these impacts. That task needs more information.[14-1,2,3,4]

15. a.) Did the assessment identify mitigation requirements for any of the DSM programs?

1. Yes 2. No

	Questions		
Region	1	2	NR
Can.	2	1	
U.S.	1	1	1
Other		2	1
Total	3	4	2
% Total	33%	44%	22%

b.) If **yes,** briefly describe the main items.

Recycling/disposal of ballasts containing PCB's Recycling/disposal of lamps containing mercury. Incineration of CFC-11 foam.
For example, recycling refrigerators required that CFC's etc. be removed and disposed of. The program was designed to permit this, and the costs of the program included it.
For our Fridge Buy-Back program - CFC's captured and recycled. - capacitors collected and ones with PCB's - stored. - Fridge hulk - recycled metal.
Mitigation (reduction of CO_2 -, NO_x and SO_2 - emissions) is the goal of the programme

c.) If **yes**, how did you determine the form of mitigation that was suggested by the assessment?

Independent analysis or interactive utility corespondence.
Environmental regulations require it.
Investigation of available disposal techniques and infrastructure.

d.) Within the assessment process at what stage were mitigation requirements, if any, identified?

1. Mitigation was identified at the scoping (initial) stage.
2. Mitigation was identified at the significance assessment stage.
3. Mitigation was identified after the assessment.
4. Other, (please specify)

	Questions				
Region	1	2	3	4	NR
Can.	1	1			1
U.S.	1		1		1
Other	2	1	1		1
Total	4	2	2	0	3
% Total	36%	18%	18%	0%	27%

Enivironmental assessment has been limited to the benefits of DSM from less electicity generation. It has not looked at the new environmental issues/costs associated with DSM resources. ([therefore] rest of questions are not applicable) [15a-2],[15d-4]

16. Who is responsible for the implementation of mitigation measures?

    1. Utility.
    2. Government (Federal, Province/State, Municipal/City).
    3. Industry.
    4. Other, (please specify)

	Questions				
Region	1	2	3	4	NR
Can.	3				
U.S.	1	1	1	1	2
Other	2	1	1		1
Total	6	2	2	1	3
% Total	43%	14%	14%	7%	21%

All of the above. It depends on the nature of your DSM programs and how they are implemented. Sometimes the customer could be considered responsible.[16-1,2,3,4]
Energy distribution companies. [16-1]
In our case, the utility would be responsible.[16-1]

17. Who is responsible for the funding of mitigation?

    1. Utility.
    2. Government (Federal, Province/State, Municipal/City).
    3. Industry.
    4. Other, (please specify)

	Questions				
Region	1	2	3	4	NR
Can.	3				
U.S.	1	1	1		2
Other	2	1	1		1
Total	6	2	2	0	3
% Total	46%	15%	15%	0%	23%

All of the above. It depends on the nature of your DSM programs and how they are implemented. Sometimes the customer could be considered responsible.[17-1,2,3,4]

18. Who is responsible for the performance monitoring of mitigation?

1. Utility
2. Government (Federal, Province/State, Municipal/City).
3. Industry.
4. Other, (please specify)

	Questions				
Region	1	2	3	4	NR
Can.	3	1			
U.S.				1	2
Other	3	1	1		
Total	6	2	1	1	2
% Total	50%	17%	8%	8%	17%

The utility would be involved in all cases - to some degree. [18-4]

19. What spatial constraints are placed upon the identification, prediction, and evaluation of environment impacts?

1. Program area.
2. Province or State.
3. Country
4. Continent
5. Other, (please specify)

	Questions					
Region	1	2	3	4	5	NR
Can.		1			1	1
U.S.	1	1				1
Other	1	1	2			1
Total	2	3	2	0	1	3
% Total	18%	27%	18%	0%	9%	27%

Differs in each case. Tends to be Province. [19-5]

20. How were the constraints in 19 determined?

By state and federal regulations/standards and or requirements. [19-1,2]
Policy/goals: Country - wide Programme: implemention by the different energy-distribution companies [19-1,3]
Province owned enterprise. [19-2]

Impact . identification:

21. a.) Does the assessment identify those groups of people that are affected by the environmental impacts of the program?

1. Yes 2. No

	Question		
Region	1	2	NR
Can.	1	1	1
U.S.		1	2
Other	1	1	1
Total	2	3	4
% Total	22%	33%	44%

b.) If **yes**, who were these groups?

22. What method was used to identify these groups?

1. Survey
2. Self-identification
3. Identified by assessment personnel.
4. Other, (please specify)

	Question				
Region	1	2	3	4	NR
Can.				1	2
U.S.		1			2
Other					3
Total	0	1	0	1	7
% Total	0%	11%	0%	11%	78%

Identified by [our utility's] DSM personnel and environment personnel.

23. a.) Were publicly valued environmental components identified?

1. Yes 2. No

	Question		
Region	1	2	NR
Can.	1	2	
U.S.		1	2
Other		1	2
Total	1	4	4
% Total	11%	44%	44%

b.) If **yes,** what were the most important?

Usually identified by utility staff. However, in some cases a university may offer expertise and/or testing in this area. [23a-2]

c.) If **yes**, which relevant group identified them?

d.) If **yes**, were desired quality standards assigned to the valued environmental components, and what were these standards?

1. Yes

2. No

	Question		
Region	1	2	R
Can.			
U.S.			
Other			
Total	0	0	0
% Total	# # #	# # #	

24. Were scientifically valued environmental components identified?

1. Yes

2. No

	Question		
Region	1	2	NR
Can.		2	1
U.S.	1		2
Other		1	2
Total	1	3	5
% Total	11%	33%	56%

25. What degree of environmental impacts are considered in the assessment?

1. Primary impacts.
2. Secondary and higher impacts.
3. Cumulative impacts.

	Question			
Region	1	2	3	NR
Can.	1			2
U.S.			1	2
Other				2
Total	1	0	1	6
% Total	13%	0%	13%	75%

26. Do you use any of the following techniques to identify impacts? (Please identify any other techniques used.)

1. Checklists.
2. Matrices.
3. Networks or tree analysis.
4. Overlays, GIS.
5. Ad Hoc.
6. Other, (please specify)

	Question						
Region	1	2	3	4	5	6	NR
Can.	1						2
U.S.						1	2
Other	1	1	1				2
Total	2	1	1	0	0	1	6
% Total	18%	9%	9%	0%	0%	9%	55%

Not really at this stage. [26-6]

Impact prediction section

27. Were probability values assigned to **impact predictions**?

1. Yes
2. No.

	Question		
Region	1	2	NR
Can.		2	1
U.S.		1	2
Other		1	2
Total	0	4	5
% Total	0%	44%	56%

28. Does the assessment specify the uncertainty and level of confidence in the **impact predictions**?

1. Yes
2. No.

	Question		
Region	1	2	NR
Can.		2	1
U.S.		1	2
Other		1	2
Total	0	4	5
% Total	0%	44%	56%

29. Do you use any of the following types of measurement for **impact prediction**?

1. **Nominal** (classified numbers without rank)
2. **Ordinal** (classified numbers, ranked numbers)
3. **Interval scale** (classified, ranked, equal intervals between numbers, zero-point is arbitrary)
4. **Ratio scale** (classified, ranked, equal intervals between numbers, zero-point is non-arbitrary) eg. weight
5. ***Other***

	Question					
Region	1	2	3	4	5	NR
Can.						3
U.S.					1	2
Other						3
Total	0	0	0	0	1	8
% Total	0%	0%	0%	0%	11%	89%

Not that I know of, our analysis is more qualitative in nature. [29-5]

30. Do you use any of the following techniques to <u>predict impacts</u>? (Please identify any other techniques used.)

1. Ad hoc committee
2. Computer modelling.
3. Professional judgement.
4. Delphi technique
5. Other, (please specify)

	Question					
Region	1	2	3	4	5	NR
Can.		1	1			2
U.S.	1	1	1			2
Other	1					2
Total	2	2	2	0	0	6
% Total	17%	17%	17%	0%	0%	50%

Impact significance:

31. Which of the following criteria are used to assess **impact significance**?

1. Changes of environmental components in relation to quality standards.
2. Changes of environmental components in relation to baseline conditions.
3. Other, (please specify)

	Question			
Region	1	2	3	NR
Can.	1	1		3
U.S.	1	1		1
Other	2	1		1
Total	4	3	0	5
% Total	33%	25%	0%	42%

32. a.) Does the **significance assessment** specify any threshold values for the environmental components?

1. Yes 2. No

	Question		
Region	1	2	NR
Can.		1	2
U.S.	1		2
Other	1	1	1
Total	2	2	5
% Total	22%	22%	56%

b.) If **yes,** how are these defined?

By EPA, NEMA or some other regulatory agency. Usually, legislation plays an important part in assigning threshold values. (ie. The "Clean Air Act")
* Maximum yearly emission of SO_2 and NO_X * Stabilisation of CO_2 - emissions in the year 1995, 3-5% reduction in 2000.

33. a.) Does the assessment determine risk of damage to environmental components?

1. Yes 2. No *3. Other*

	Question			
Region	1	2	3	NR
Can.		1		2
U.S.			1	2
Other	1	1		1
Total	1	2	1	5
% Total	11%	22%	11%	56%

Sometimes - but not in great detail at the utility level. The EPA likes to play that game. [33a-3]

b.) If **yes,** how was the public perception of risk correlated to its scientific assessment?

Impact evaluation:

34. Is the assessment **impact evaluation** method easy for non-experts to understand?

1. Yes 2. No

	Question		
Region	1	2	NR
Can.	2		1
U.S.		1	2
Other	1	1	1
Total	3	2	4
% Total	33%	22%	44%

35. a.) Does the **impact evaluation** method use a common measurement unit?

1. Yes 2. No *3. Other*

	Question			
Region	1	2	3	NR
Can.		2		1
U.S.	1			2
Other	1		1	1
Total	2	2	1	4
% Total	22%	22%	11%	44%

b.) If **yes,** what kind of unit is used?

For example: If you are a Green Lights Partner - the EPA has a special report that identifies how much NOx or CO2 has been reduced from power plant emissions.
Tons CO_2, NO_x, [and] SO_2

36. Do you use any of the following types of measurement for **impact evaluation**?

1. **Nominal** (classified numbers without rank)
2. **Ordinal** (classified numbers, ranked numbers)
3. **Interval scale** (classified, ranked, equal intervals between numbers, zero-point is arbitrary) eg. temperature in Celsius/Fahrenheit
4. **Ratio scale** (classified, ranked, equal intervals between numbers, zero-point is non-arbitrary) eg. weight
5. ***Other***

	Question					
Region	1	2	3	4	5	NR
Can.						3
U.S.					1	2
Other						3
Total	0	0	0	0	1	8
% Total	0%	0%	0%	0%	11%	89%

37. a.) Is a weighting scheme developed for environmental impacts and environmental components?

1. Yes
2. No

	Question		
Region	1	2	NR
Can.		2	1
U.S.		1	2
Other		1	2
Total	0	4	5
% Total	0%	44%	56%

b.) If **yes**, who develops the weighting scheme for environmental impacts and components?

1. Assessment team.
2. Utility.
3. Provincial/state government.
4. Federal Government
5. Public
6. Other, (please specify)

	Question					
Region	1	2	3	4	5	6
Can.						
U.S.						
Other			1	1		
Total	0	0	1	1	0	0
% Total	0%	0%	50%	50%	0%	0%

c.) If **yes**, how is the weighting scheme developed?

38. a.) Does the EA consider alternatives to the proposed program? (Please give examples of these alternatives and the number of them.)

1. Yes. 2. No. *3. Other*

	Question			
Region	1	2	3	NR
Can.	1	1		1
U.S.			1	2
Other		1		2
Total	1	2	1	5
% Total	11%	22%	11%	56%

Not necessarily. [38a-3]
It compares environmental conditions with and without the DSM measure. Without the measure, the energy will come from supply side resources. [38a-1]

b.) If **yes**, is the "no action" alternative considered?

1. Yes 2. No

	Question	
Region	1	2
Can.	1	
U.S.		
Other		1
Total	1	1
% Total	50%	50%

39. Does the EA develop a single measure that consolidates the impacts of each alternative?

1. Yes. 2. No.

	Question		
Region	1	2	NR
Can.		1	2
U.S.		1	2
Other		1	2
Total	0	3	6
% Total	0%	33%	67%

40. a.) Is sensitivity analysis (the application of a range of variables to determine the influence of those variables on the outcome of the analysis) conducted on the weighting values or other variables in the assessment?

1. Yes.
2. No.

	Question		
Region	1	2	NR
Can.		1	2
U.S.		1	2
Other		1	2
Total	0	3	6
% Total	0%	33%	67%

Not sure. [40a-2]

b.) If **yes** which variables?

41. Do you use any of the following techniques to <u>evaluate impacts</u>? (Please identify any other techniques used.)

1. Ad hoc committee
2. Decision analysis.
3. Matrices.
4. Tabular comparison of alternatives.
5. Aggregation of impacts on alternatives
6. Cost-benefit analysis.
7. Other, (please specify)

	Question							
Region	1	2	3	4	5	6	7	NR
Can.								3
U.S.	1			1		1		2
Other	1					1		1
Total	2	0	0	1	0	2	0	6
% Total	18%	0%	0%	9%	0%	18%	0%	55%

Monitoring:

42. a.) Is any monitoring of the DSM programs performed?

1. Yes 2. No

	Question		
Region	1	2	NR
Can.	2	1	
U.S.	1		2
Other	2	1	
Total	5	2	2
% Total	56%	22%	22%

b.) If **yes**, why is this being done?

1. Determine regulatory compliance
2. Mitigation effectiveness
3. Public demands
4. Prediction accuracy
5. Hypothesis testing.
6. Other, (please specify)

	Question					
Region	1	2	3	4	5	6
Can.	1	1	1	1	1	1
U.S.	1			1		
Other		1	2	1		1
Total	2	2	3	3	1	2
% Total	15%	15%	23%	23%	8%	15%

Load monitoring and market research information is used in developing programs and in assessing their success. [42b-4,5,6]
Determine compliance of goals. [42b-2,3,6]

43. Does the public participate in the monitoring process?

1. Yes 2. No *3. Other*

	Question			
Region	1	2	3	NR
Can.		1	1	1
U.S.	1			2
Other	1	1		1
Total	2	2	1	4
% Total	22%	22%	11%	44%

If **yes**, what is the public's role?

Customers will allow us to meter their equipment.
Participation in surveys and focus groups.

44. What is the duration of the monitoring program?

Ranges from 2 wks for pre-retrofit to 2-wks past-retrofit to one year or two.
Ongoing.
Start 1990 End date not indicated. Structural activity

45. Who is responsible for monitoring?

1. State/Provincial governments
2. Federal government
3. Municipal/City government
4. Utility
5. Other, (please specify)

	Question					
Region	1	2	3	4	5	NR
Can.	1	1		2		1
U.S.				1		2
Other				2		1
Total	1	1	0	5	0	4
% Total	9%	9%	0%	45%	0%	36%

46. a.) Are you aware of any other survey of the application of environmental impact assessment to utility DSM programs **or** an environmental assessment of a DSM program?

1. Yes 2. No

	Question		
Region	1	2	NR
Can.	1	2	
U.S.	1	1	1
Other	1		2
Total	3	3	3
% Total	33%	33%	33%

b.) If **yes**, where could I obtain information about this survey or an environmental assessment of a DSM program?

You might try contacting the Electric Power Research Institute or the Environmental Protection Agency.

See attached abstract on paper by Haites, Hashem and Jean. Haites is at the Barakat & Chamberlin offices in Toronto
KEMA - report 12306 - KEC - 91-343 (Milieu - effect rapport by Structeurschema Electriciteit voorziering) P.O.Box 9035, 6800 ET. Arnhem, Tel (085) 569111 Telex 45016 Kema

If <u>part B</u> is completed then <u>part C</u> should be left unanswered.

Part C

1. Please give the reasons for not performing an environmental assessment (EA).

We have no real examples of Demand Side Management
In our municipal utility, DSM is performed to lower our bill of electrical energy purchases. The pricing already includes environmental signals which are programmed at the provincial level ([The provincial utility] and the government).
DSM as such is not a significant feature of the UK ESI due to non-vertical integration, and the central regulatory regime. However, customers do respond to pricing messages to curtail load. This is a relatively recent development, and I am not aware of any EA on the reduced requirement for generation capacity.
Potential impacts of a major or practical significance are handled during the implementation of the DSM program.
We were directed by the Public Service Commission to implement a DSM program for the year 1992 and 1993. Likely we will continue the program in future years when we may consider performing an EA.
Not required
Not required in our jurisdiction.
Projects/programs are relatively small.
- Staffing problems. - No methodology to base assessments on.
Has not been considered by the company or by regulators and has not been as important as getting high quality DSM programs operating.
- No staff. - Don't know the $ value of reduction in pollutants.
There is no reason for <u>not</u> performing an EA. DSM , as practised in the USA, is not as advanced in the UK - regulatory control [body] does not allow utilities to make agreed rates of return on reducing sales: [increasing sales produces an increasing return].
Our company is not currently working with DSM activities.
- Have not started DSM programs. - Do not have generating facilities.
We are a small utility participating with a larger utility... in a DSM program... Any environmental assessment wil be done by them.
Only one pilot DSM project undertaken to date.

2. a.) Do you intend to do EA work on your DSM programs in the future?

1. Yes 2. No *3. Other*

	Question			
Region	1	2	3	NR
Can.	2	4		
U.S.		2	2	
Other	2	2	1	1
Total	4	8	3	1
% Total	25%	50%	19%	6%

b.) Can you give reasons for this decision?

1) provincial authority gives the pace through the pricing of electric energy; 2) cost of such evaluations; 3) people here already "environmentally friendly" through participation in our programs. [2a-2]
If DSM does become a major feature, then it is likely that EA will be carried out. We are involved in reviewing the environmental impact of our business activities. [2a-3]
- Cost - Limited need has been identified. [2a-2]
Too early in the program. [2a-3]
Only if required. At this time our programs delay the requirement for new generation at worst and at best eliminate it altogether. Their is no real impact except very positive in favor of the programs. Their is some small negative impact perhaps in the manufacture of the energy efficient products. But even those can be cancelled out with these factories using DSM materials themselves. [2a-2]
No clear demand or direction to do so. Some environmental decisions are currently considered in our program decisions, but are not based on a formal environmental assessment.
With KW rates as high as 27 $/KW during peak, incentive is high to develop program with higher impact - [2a-1]
We may do some in the future, but it is undetermined whether we will have time, money, or methodology to do a meaningful assessment. [2a-3]
Has not been considered. [2a-2]
We believe EA should be factored into DSM evaluations. [2a-1]
A "prototype" DSM programme is being developed as part of an Integrated Resource Planning study IRP encompassing many aspects of demand in parallel with generation options. - it will be the generation side options which will require EA - eg. new diesel sets, pumped storage hydro scheme, wind turbines [2a-1]
If we decide to implement DSM programs we will consider to make relevant EAs. [2a-2]
Do not have generating facilities.[2a-2]
We are a small utility participating with a larger utility... in a DSM program... Any environmental assessment wil be done by them.[2a-2]
Desirable to consider balance of overall work.[2a-1]

3. Please provide a brief description of what work an environmental assessment would include and the level of detail in the analysis.

It is difficult to comment, but it likely to include energy & emission savings, reduced requirement for generation/distribution plant. Economic welfare benefits.
- No plans have been made.
Not known at this time.
Unknown
It would depend on the direction provided.
- Noise - Visual - Traffic generated - Schedule of usage
An integrated resources assessment would analyze environmental impacts of supply and demand resources. This would include environmental impacts from the manufacturing/refining process through operation to disposal.
- Cost and impact of pollutant reductions.
- the EA would be on generation projects, not DSM programmes.

4. Do you have an environmental department or environmental specialist on staff?

1. Yes
2. No
3. Other, (please specify)

	Question			
Region	1	2	3	NR
Can.	1	6	1	
U.S.	3	1		
Other	3			2
Total	7	7	1	2
% Total	41%	41%	6%	12%

Environmental department of 30 staff members.
Not as a member of the DSM staff. [4-2]
The environmental specialist deals with transmission and distribution issues not [with] DSM. [4-1]
environmental engineering capacity in-house; EA would probably be done by external consultants. [4-1]
The city has an environmental committee. Mostly involved in waste management.[4-2,3]

5. Who would likely perform an environmental assessment?

1. Utility Environmental Dept.
2. Utility DSM Dept.
3. Outside agency, (please specify)
4. Outside consultant, (please specify)
5. Other, (please specify)

	Question					
Region	1	2	3	4	5	NR
Can.	1	1	2	4		
U.S.	1		1	2	1	
Other		1	1	1		3
Total	2	2	4	7	1	3
% Total	11%	11%	21%	37%	5%	16%

Bonneville Power Administration. [5-3]
Environmental specialist. [5-4]
Combination of Environmental Dept., Resource Planning, DSM Dept. and other parts of company. [5-5]
3 or 4 no specific procedure in place. [5-3,4]
Referrals would be sought. [5-4]
Generating utility providing bulk electrical service, assuming one is necessary.[5-3]
[The utility that supplies us our electricity.] [5-3]

6. How would the results of an environmental assessment influence the design of your DSM program?

DSM activities that produced the most appropriate reward to the greatest degree would be concentrated on.
Too early in to determine.
If they benefited the program, the results could be passed on to Government to determine if the utility would be allowed to pay for the programs out of a new tax on "users" of the environment. This would decrease the impact of DSM on rates and allow the costs to be bourne by the people responsible for using the environment.
Depends on the outcome of the assessment. Possibly the legal force behind any request for an environmental assessment.
To the point of modifying project within budget.
Haven't thought to that level of detail yet.
We are required to include environmental externalities, at costs determined by the ...[State's utility regulatory board] when evaluating supply and demand resource options. These have only been set on supply. If an assessment concluded they should be included in demand, they would be used in selecting least-cost resources.
Programs with minimal environmental impacts would be favored over more damaging programs.
A "prototype" DSM programme is being developed as part of an Integrated Resource Planning study IRP encompassing many aspects of demand in parallel with generation options. - it will be the generation side options which will require EA - eg. new diesel sets, pumped storage hydro scheme, wind turbines - the EA would be on generation projects, not DSM programmes.
Rate structure changes.
Only proceed if acceptable/improved environmental impact.

7. Please describe how the results of an environmental assessment could influence the costs of your DSM program.

Costs will not be influenced by results
- Would certainly add to the overhead
Too early to determine.
If the program costs were offset by a legislated tax [on users of the environment then] ...costs would decrease for the utility. The type of tax of course may determine whether overall cost savings available to all customers or just participants in the DSM programs.
Depends on the outcome of the EA.
- Sound barriers (equipment), - Visual screen (planting trees).
Haven't thought to that level of detail yet.
The present regulations increase their costs effectiveness. How an integrated resource assessment could influence the costs is unclear.
An EA could help reduce the effective costs of a DSM program by showing the environmental savings.
- the DSM ideas are based on cost-cutting to improve the power station load profile > improve operational efficiency. - not to reduce gas emissions; there are limits on SO_X/NO_X emissions imposed by the European Community directives on combustion plant.
Rate structure changes.
They would be considered and included - Project will still have to be cost effective.

8. Please describe how the results of an environmental assessment could influence the time required to implement your DSM programs.

Any benefit identifed from EA would influence the decision to the speed of the DSM program.
- Would probably lengthen it
Too early to determine.
Depending upon the money received from taxes to pay for DSM,the implementation time is limited by the utilities ability to hire extra staff as required. This of course assumes that load is still growing and excess generation does not exist.
Depends on the outcome of the EA.
Longer construction. Long delivery items.
Haven't thought to that level of detail yet.
It is assumed we would not stop existing programs pending results. It may slow the implementation of new programs.
This would obviously delay implementation of some DSM programs.
Regulatory requirements are the biggest obstacle to any DSM programs. - the regulatory influence in the UK acts against DSM based on environmental considerations.
Frequency of rate changes.
Uncertain

9. At what point within the utility's planning & decision process would an assessment be performed?

1. Power resource plan
2. Overall DSM program plan
3. Individual DSM program plan
4. Other, (please specify)

	Question				
Region	1	2	3	4	NR
Can.	1	2	5		1
U.S.	1	1		2	
Other			1	1	3
Total	2	3	6	3	4
% Total	11%	17%	33%	17%	22%

Don't know. [9-4]
Integrated resource plan, which may be what you mean by Power Resource Plan, I am not familiar with that term. [9-4]
- we are at the earliest stages in developing ideas for a specific, local, trial DSM program. [9-4]
Early planning stage.[9-3]

10. As a DSM plan progresses from the Power Resource plan of the utility to the development of detailed individual programs, would you perform different levels of environmental analysis on these DSM programs (eg. increasing complexity of analysis as the DSM program moves towards implementation)?

1. Yes 2. No 3. Other, (please specify)

	Question			
Region	1	2	3	NR
Can.	2	2	1	2
U.S.		1	3	
Other		1	1	2
Total	2	4	5	4
% Total	13%	27%	33%	27%

Not known at this time. [10-3]
If money were available on the basis of reducing environmental impact of generation. Each program would have to be studied individually to determine costs/benefits. [10-1]
Don't know; we are not considering environmental analysis implicitly in program decisions. [10-3]
We have not thought to that level of detail yet. [10-3]
These processes have still to be developed in the U.K. [10-3]
Complexity would be related to size of change. [10-3]

11. Can you give reasons for the approach indicated in 10?

Detailed analysis of individual programs would identify the most beneficial and therefore the best projects to pursue, as you outline in you notes on p.16. [10 - 4]
Economic. [10-1]
All planning is done on an integrated resource basis. [10-2]
The EA would be done in detail for each program. [10-2]
Negative regulatory influence. [10-3]
Small changes do not warrant the cost.[10-3]
Scale of schemes not sufficiently large to influence further change.

12. What would you expect would be the degree of public/interest group participation in DSM environmental assessments?

1. None
2. Survey of public opinion.
3. Public forums.
4. Public hearings
5. Other, (please specify)

	Question					
Region	1	2	3	4	5	NR
Can.	3		1	1	1	1
U.S.		1	1	2	3	
Other		1	1	1	2	3
Total	3	2	3	4	6	4
% Total	14%	9%	14%	18%	27%	18%

Regulatory agencies. [12-5]
Unknown [12-5]
Opportunities would be provided to the public & interest groups, but could take any of the forms above. [12-2,3,4,5]
any DSM programme would represent significant innovationin the UK context - consequently such radical change would require positive marketing, assuming any DSM motivated by environmental influences. [12-2,3,4,5]
We have worked with a variety of organizations in establishing DSM plans and programs: Either formally or informally this would likely continue. [12-5]
- Consultation with consumers committee/lobby groups. - Likely interest after successful implementation.[12-5]

13. Do you think your utility will perform life cycle analysis?

1. Yes. 2. No. 3. *Other*

	Question			
Region	1	2	3	NR
Can.	2	3	1	1
U.S.	1	2	1	
Other	2	1	1	1
Total	5	6	3	2
% Total	31%	38%	19%	13%

[Life cycle analysis on final disposal and recycling.] [13-1]
I don't know the answer, if this approach was to be developed here, then I would be interested to apply it. [13-3]
Yes to both [que. 13 and 14] if we did an assessment, but. an assessment is not likely at this time. [13-3]
Perhaps in the future - I think that this is an important issue [Life cycle analysis of DSM programs}, however - My limited investigations have uncovered little information on the subject. - If you can provide any references on this subject I would be interested. [13-3]

14. Do you think your utility will require life cycle analysis of DSM products from the suppliers of those products?

1. Yes. 2. No. *3. Other*

	Question			
Region	1	2	3	NR
Can.	3	2	1	1
U.S.		2	1	1
Other	2	1	1	1
Total	5	5	3	3
% Total	31%	31%	19%	19%

[Life cycle analysis on final disposal and recycling.] [13-1]
I don't know the answer, if this approach was to be developed here, then I would be interested to apply it. [14-3]
Yes to both [que. 13 and 14] if we did an assessment, but. an assessment is not likely at this time. [14-3]
Perhaps in the future [14-3]

15. What spatial constraints would be placed upon the identification, prediction, and evaluation of environment impacts?

1. Program area.
2. Province or State.
3. Country
4. Continent
5. Other, (please specify)

	Question					
Region	1	2	3	4	5	NR
Can.	2	3				2
U.S.	1				2	1
Other	1	2			1	3
Total	4	5	0	0	3	6
% Total	22%	28%	0%	0%	17%	33%

Don't know. [15-5]
Resource options are evaluated on a societal basis, leaving this very open. [15-5]
Global [15-1,2,5]
Initially our trial IRP/DSM project is restricted to a geographically distinct island network [15-2]

16. How would the constraints in 15 be determined?

Limits of our service area. [15-1]
Jurisdiction of ...[provincial] regulatory and appeals commission. [15-2]
Don't know. [15-5]
Measurements in the field (noise...).
With guidance from regulators and others. [15-5]
[Utility] has defined boundaries. [15-1]
1. Town districts: NOx, SOx and dust contents in the air. Noise levels 2. Region: NOx and SOx contents in air and soil. 3. Global: emission of greenhouse gases and ozon[e] destructiveness ie. CO and CFC - gases. [15-1,2,5]

Impact identification

17. Which of the following techniques would you use to identify impacts? (Please identify any other techniques that would be used.)

1. Checklists.
2. Matrices.
3. Networks or tree analysis.
4. Overlays, GIS.
5. Ad Hoc.
6. Other, (please specify)

	Question						
Region	1	2	3	4	5	6	NR
Can.	1			1		1	4
U.S.		1				2	1
Other	2		1				3
Total	3	1	1	1	0	3	8
% Total	18%	6%	6%	6%	0%	18%	47%

Not known at this time. [17-6]	
Don't know. [17-6]	
Unknown [17-6]	
Not certain - This is a new area and we will explore all techniques pertinent to specific projects. [17-NR]	

Impact prediction:

18. Which of the following techniques would you use to predict impacts? (Please identify any other techniques that would be used.)

1. Ad hoc committee
2. Computer modelling.
3. Professional judgement.
4. Delphi technique
5. Other, (please specify)

	Question					
Region	1	2	3	4	5	NR
Can.		1	2		1	4
U.S.		1			2	1
Other	1	2	3			2
Total	1	4	5	0	3	7
% Total	5%	20%	25%	0%	15%	35%

Not known at this time. [18-5]
Don't know [18-5]
Unknown [18-5]

Impact evaluation:

19. a.) Do you think the environmental assessment would consider alternatives to the proposed program. (Please give examples of these alternatives and the number of them).

1. Yes. 2. No.

	Question		
Region	1	2	NR
Can.	3	1	3
U.S.	1	1	2
Other	2		3
Total	6	2	8
% Total	38%	13%	50%

Provided they had similar impact and similar costs. [19a-1]
It would mirror our present DSM planning which looks at many alternatives.[19a-1]
Proceed or not proceed.[19a-1]

b.) If **yes**, would the "no action" alternative be included?

1. Yes 2. No

	Question	
Region	1	2
Can.	3	
U.S.	1	
Other	1	
Total	5	0
% Total	100%	0%

20. Which of the following techniques would you use to evaluate impacts? (Please identify any other techniques that would be used.)

1. Ad hoc committee
2. Decision analysis.
3. Matrices.
4. Tabular comparison of alternatives.
5. Aggregation of impacts on alternatives
6. Cost-benefit analysis.
7. Other, (please specify)

	Question							
Region	1	2	3	4	5	6	7	NR
Can.				2		3	1	3
U.S.						1	1	2
Other	1	2		1	1	2		3
Total	1	2	0	3	1	6	2	8
% Total	4%	9%	0%	13%	4%	26%	9%	35%

Not known at this time. [20-7]
Unknown [20-7]
Not certain - This is a new area and we will explore all techniques pertinent to specific projects. [20-NR]

Monitoring:

21. a.) Would any monitoring of the environmental impacts of the DSM programs be performed?

1. Yes 2. No *3. Other*

	Question			
Region	1	2	3	NR
Can.	3	1		3
U.S.	2		1	1
Other	4			1
Total	9	1	1	5
% Total	56%	6%	6%	31%

b.) If **yes**, why would this be done?

1. Determine regulatory compliance
2. Mitigation effectiveness
3. Public demands
4. Prediction accuracy
5. Hypothesis testing.
6. Other, (please specify)

	Question					
Region	1	2	3	4	5	6
Can.		1		2	1	
U.S.	1			1		1
Other	2	1	1	4	3	
Total	3	2	1	7	4	1
% Total	17%	11%	6%	39%	22%	6%

Possibly for all of the above. [21a-6]
Through regulators.

22. a.) Would the public participate in the monitoring process?

1. Yes 2. No *3. Other*

	Question			
Region	1	2	3	NR
Can.		3	1	3
U.S.	1	1	1	1
Other	3	1		1
Total	4	5		5
% Total	29%	36%	0%	36%

Unknown [22a-3]
Possibly [22a-3]
- selected groups of representative customers will be monitored to provide modelling/ forecasting data. [22a-1]
Questionnaires & Surveys.[22a-1]

b.) If **yes**, what would the public's role be?

Survey of opinions. Installation of monitoring equipment.
Through regulators. [22a-1]
Possibly.
12 mths. initially

23. What would be the duration of the monitoring program?

Not known at this time.
It would depend on what we were monitoring & what we were trying to determine.
Start-up period (testing) + 1 full seasonal cycle (1 year).
Program life and beyond.
Since we have no experience of EAs of DSM activities this is impossible to answer at present.
Unknown
5-10 years.
[1 year]

24. Who would be responsible for monitoring?

1. State/Provincial governments
2. Federal government
3. Municipal/City government
4. Utility
5. Other, (please specify)

	Question					
Region	1	2	3	4	5	NR
Can.	2		1	2		3
U.S.	1			2	1	1
Other			1	3		1
Total	3	0	2	7	1	5
% Total	17%	0%	11%	39%	6%	28%

Don't know. [24-5]

Mitigation:

25. Within the assessment process at what stage would mitigation requirements, if any, be identified?

1. Mitigation identified at the scoping (initial) stage.
2. Mitigation identified at the significance assessment stage.
3. Mitigation identified after the assessment.
4. Other, (please specify)

	Question				
Region	1	2	3	4	NR
Can.	1	1	2		4
U.S.	1			1	2
Other	2	2	1		2
Total	4	3	3	1	8
% Total	21%	16%	16%	5%	42%

Not known at this time. [25-4]

26. What criteria would determine whether an impact warrants mitigation?

1. Impact significance (importance).
2. Impact magnitude.
3. Impact area (Public safety, wildlife, etc.)
4. Impact probability.
5. Other, (please specify)

	Question					
Region	1	2	3	4	5	NR
Can.	3	3	4	2		3
U.S.	2	1	1		1	1
Other	2	2	1	1		3
Total	7	6	6	3		7
% Total	24%	21%	21%	10%	0%	24%

Depends on the impact. [26-1,2,3,4]
Possibly all [26 -5]

27. Who would be responsible for the implementation of mitigation procedures?

1. Utility.
2. Government (Federal, Province/State, Municipal/City).
3. Industry.
4. Other, (please specify)

	Question				
Region	1	2	3	4	NR
Can.	3	4			2
U.S.	2	1	1	1	1
Other	2	1			2
Total	7	6	1	1	5
% Total	35%	30%	5%	5%	25%

It's not clear who would be responsible. [27-4]
Combination of above.

28. Who would be responsible for the funding of mitigation?

1. Utility.
2. Government (Federal, Province/State, Municipal/City).
3. Industry.
4. Other, (please specify)

	Question				
Region	1	2	3	4	NR
Can.	4	5	1		1
U.S.	1			2	1
Other	3	1			2
Total	8	6	1	2	4
% Total	38%	29%	5%	10%	19%

It would probably depend on the type of program & type of measures installed.[28-4]
Each sector would pay per unit of pollution reduced. [28-4]
Combination of above. [27-1,2,3]

29. Who would be responsible for the performance monitoring of mitigation?

1. Utility
2. Government (Federal, Province/State, Municipal/City).
3. Industry.
4. Other, (please specify)

	Question				
Region	1	2	3	4	NR
Can.	4	4			1
U.S.	1			2	1
Other	3	1			2
Total	8	5	0	2	4
% Total	42%	26%	0%	11%	21%

It would depend on the type of program & type of measures installed. [29-4]
Each sector would monitor its pollution. [28-4]

30. a.) Are you aware of any other survey of the application of environmental impact assessment to utility DSM programs **or** an environmental assessment of a DSM program?

1. Yes 2. No

	Question		
Region	1	2	NR
Can.		7	1
U.S.		3	1
Other		3	2
Total	0	13	4
% Total	0%	76%	24%

b.) If **yes**, where could I obtain information about this survey or an environmental assessment of a DSM program?

Additional comments not part of comments on questionnaire

Note: These comments are paraphrased unless quotation marks are used.

A.) Reasons for not filling out questionnaire or having trouble doing so.

"We have no examples of DSM in our utility...Hence we have been unable to complete form sensibly."
Our utility has no DSM program...DSM is conducted by our distribution utilities.
DSM has not been adopted by New Zealand Utilities except for an existing program on load control of water heating.
Our utility is too small to perform environmental studies itself.
Lack manpower to complete questionnaire.
Do not have approval for our DSM program at this time and cannot determine a methodology for considering the environmental effects of our DSM programs.
EA needs to be defined within the questionnaire.
We do not have a DSM program therefore the questionnaire is irrelevant.
We participate in another utilities DSM program and they will answer the questionnaire.
We have not "performed environmental assessments of our demand-side management programs and are not in a position to make comments."

B.) Comments on the environmental impact assessment of DSM programs

"Our environmental programs are designed to encourage the highest levels of energy efficiency. However, as generation margins are so large [in England], there is less need to develop campaigns to the same levels as Canada and the USA."
"the energy consultants in our advice center try to take environmental impacts of products into consideration."

"The real need is to develop a resource effective framework for environmental assessment of DSM programs. Such a goal would contribute more to advancing the state-of-the-art and getting industry involved in doing environmental assessments."
Although a DSM EIA has not been performed "energy savings and related emission reductions are factored into emission reduction targets required by environmental regulations/agreements." EA's are done on main supply side projects.
The Sofia and Helsinki protocols (attempting to reduce NOx and SOx emissions) influenced our decision to implement DSM programs. We are intiating Integrated Resource Planning and in "a few months time we expect to be able to assess the impact of our DSM program on these wider environmental issues".
For this region "there is little analytical link between environmental assessment and DSM. Given that we have an electric heat market share dominance on a progressively thermal system, it is an area of considerable interest."
- "The financial value of "environmental adders" ...continue to be ignored [in the UK] when costing the production of electricity in comparison to the cost of any DSM measures."
Our company has performed "informal assessments of the effects of its programs on indoor air quality"
The Swedish government has introduced a bill on recycling of energy and material that stresses "Producers responsibility". "This means that the producers shall base their manufacturing of goods on conservation of resources. The basic idea is that consideration to the waste problem shall be taken already in the beginning of the creating a new product.
Environmental factors are taken into account when our utility's DSM programs are designed without using an EIA. Our old refrigerator replacement program included the recycling of refrigerant, metals and some spare parts, proper disposal of CFC blown insulation. A mercury vapour to Sodium vapour rural yard lamp conversion program used an existing utility process to handle PCB containing capacitors from lamp waste. A fluorescent lamp program did not include special measures for disposing of the mercury containing lamp waste generated since "society has not decided this to be a major environmental problem."

c.) DSM comments

New Zealand is reforming its electrical utility through two paths: Deregulation and creation of a competitive wholesale market for electricity. - presently half-hourly time of use pricing is being introduced to "signal marginal costs to customers at the time of day and year that these are incurred...overall objective of recent reforms is to encourage the optimum level of DSM in end use markets by means of market forces rather than through utility led programs, such as least cost planning." - Deregulation of electricity retailers and the abolition of franchise areas. "Energy suppliers are encouraged to shift their focus away from selling a commodity (Kilowatt hours) to a value added approach emphasising energy services" - Utility formed energy service groups are attempting to encourage energy efficiency through "promotion of the systematic use of electro-technology and services to maximise customer values from energy use...to reduce the total cost to the end use customer for a given volume of output or level of service."
In the Netherlands the production and distribution of electricity is seperated due to legislation. Our production company is "mainly dedicated to increasing the (environmental) efficiency" of the processes that we use to generate electricity. It is the distribution companies that are primarily involved in energy saving programs.
- The electricity market in Sweden is not highly regulated with few supervising authorities or administrative bodies. Our market is moving towards greater competition with new laws proposed to regulate the market similar to Great Britain and Norway. The introduction of an Electricity Exchange has been proposed. - DSM is not performed in seperate departments in Swedish utilities, instead the efficient use of energy (decreasing and increasing use of "electricity as well as fuels") is a part of the marketing divisions in our companies. The efficient use of energy includes consideration of environmental costs and benefits. -
The UK utility regulatory framework is such that shareholder returns must be maximised, thus sales must be also maximised. This has led to a situation where no DSM programs have been adopted because they would reduce sales.

Appendix D

Program and Policy EA- Case Studies

There are several examples of environmental assessment being applied to programs. The utility survey provided information about some examples of program assessment. This discussion will attempt to bring together a few other examples of program assessment to supplement the survey findings. Two of these examples include programs other than DSM programs to display a variety of approaches that are being used and their characteristics.

1.0 Netherlands Ten-Year Programme on Waste Management EA

The Netherlands Waste Management Council "Afval Overleg Orgaan" (AOO) performed an EA of its Draft Ten-Year Programme on Waste Management 1992-2002 (TPWM), resulting in an environmental impact statement. This EA was voluntarily performed by the council. The TPWM had as its objective the organization and direction of waste disposal throughout the Netherlands; this included planning the "framework" in which the waste disposal system should develop to handle increasing quantities of solid waste in the future (AOO 1992:223).

The approach to this EA involved comparing an adopted policy plan for waste disposal and a variant of the adopted policy plan to several alternatives. The adopted policy plan was the plan being implemented at present. The variant of this plan was included to indicate the effect of pre-separation of municipal solid waste being replaced by incineration. These were not easily realizable alternatives, but rather distinctive alternatives that would indicate the full impact of following a certain policy (e.g., One alternative had no expansion of incineration, no expansion of waste pre-separation, and the dumping of remaining waste). The comparison of alternatives was performed on the basis of predicted solid waste processing in the year 2000, and it was also performed for a "head wind-scenario" that foresaw an increasing rate of waste being processed.

The results of the EA were meant as guidance to the further development of the waste disposal plan. Therefore one should consider this EA to be early in the planning process.

The objectives of the EA were to compare environmental effects of alternative solid waste management practices. The scope of the EA was wide in terms of the range of impacts and alternatives considered (diverse differences between waste disposal methods). It also considered more than one baseline prediction for solid waste. The environmental analysis considered the effects of changes to the environment as opposed to the impacts to individual components of the environment. Although this EA did not extend the analysis of the environmental changes to a determination of direct impacts on environmental components at individual sites, this form of analysis was used to consider the aggregate impacts of waste disposal actions on a national basis. Environmental changes with similar impacts were grouped together as statistical indicators (e.g., climatic change included the greenhouse gases).

Statistical indicators were created for the most important areas of waste disposal. These "environmental themes" each had various environmental actions and units by which the actions were measured (AOO 1992:230-1). One theme is Dispersion which included such environmental actions as Heavy Metal, Dioxin, and Organic Substance releases. Other themes included Climatic Change with environmental actions from methane and carbon dioxide gas.

The evaluation of alternatives involved comparing the changes to the environment from the various alternatives through tables, graphs, and discussion. The information required to produce this EA was limited to working out projections of waste processing for the year 2000 which were provided from the TPWM. Calculations for waste processing assumed average characteristics for disposal facilities.

This EA approach is fairly flexible when applied to a program where determining the changes to the environment, as opposed to the impacts on environmental components, provides sufficient information for choosing the most environmentally desirable alternative. Since the determination of environmental changes is not solidly linked to a site-specific analysis this approach can be applied to another program using different generic impact estimates. The public had opportunities to voice their opinion through interest group participation on the waste committee. Mitigation measures were not mentioned although probably assumed for each alternative in order to meet regulatory requirements. Monitoring was not discussed in this EA.

2.0 Ontario Hydro's Supply Side Environmental Effects EA

Ontario Hydro performed an environmental analysis of the supply-side environmental effects of its DSM programs for its 1989 Demand/Supply Plan. In 1992 this analysis was updated for the study period 1992 to 2017 for the Demand/Supply plan update - 1992 (Ontario Hydro 1992). This analysis provided an outline of DSM programs along with projections for the yearly demand management values in the study period. Natural environmental effects were predicted for alternatives and these were in turn evaluated.

The objective of this plan was to determine the indirect (supply side) effects of the DSM programs in the study period.

The range of effects was restricted to the cumulative supply side effects for the study period. The direct effects of DSM programs were not considered. The study considered but did not fully evaluate cradle-to-grave effects outside the province (e.g., Coal mining). Natural environmental criteria were used to group the effects being studied. These included resource use criteria such as Non-Renewable Resources, Land use, Water use. Emissions, Effluents, and Wastes formed another group of criteria that included Atmospheric Emissions, Aquatic Effluents, and Solid Waste production. Environmental components were chosen from these criteria areas; an example is Land use where total land area requirements for mining, power plant facilities, transmission lines, hydro-electric flooding, waste storage and disposal were determined (Ontario Hydro 1992:A-3). The selection of criteria was in part influenced by the need for quantitative measures of environmental effects for comparison purposes as well as calculation of the net indirect effects of DSM programs (Ontario Hydro 1992:A-2).

This approach is similar to the previous one (TPWM) where significance was determined by comparison with an alternative. Impact prediction utilized generic environmental change estimates, and like the TPWM the use of these estimates makes this a flexible approach that can be applied to another program using different environmental change estimates.

This approach considers all DSM programs related to their supply side effects, but it fails to consider the direct effects of DSM programs thus limiting its usefulness somewhat.

Another limitation to its usefulness is the consideration of only one alternative. In a sense no alternatives are considered since this alternative only represents a baseline by which the effects of the present programs are determined. This can best be described as a planning alternative similar to the one used for planning in the program EIA of the Netherlands ten year waste management plan.

Ontario Hydro's approach compared the effects of two demand/supply plans, a hypothetical plan (no DSM programs) and the present plan (update-nuclear median load forecast plan, represented in the Demand/Supply Plan Update - 1992). The supply side effects of the DSM programs were determined by finding the difference between the cumulative effects of the two plans. The evaluation of alternatives involved the comparison of the changes in environmental components of alternatives through tables, graphs, and discussion.

The resource requirements for this analysis were limited to the need for a load forecast and determination of "generic" estimates of environmental changes for typical generation and transmission facilities.

The public would have been involved through the EIA hearings for the Demand/Supply plan. There is no mention of whether the public was consulted or involved in the update report.

3.0 <u>Bonneville Power Administration Resource Program EA</u>

The Bonneville Power Administration (BPA) is a U.S. federal government agency that provides power to utilities in the northwestern U.S. states (Idaho, Oregon, Washington, Montana west of the continental divide and small parts of Wyoming, California, Nevada and Utah.) BPA performed an EA of the power resource options available to it until the year 2020. This is a broad programmatic EA that is intended to be followed later by more site specific EAs as required. Since BPA has performed DSM program EAs in the past (section 4) one could assume the situation would be the same for certain DSM programs. The main purpose of the document is to "evaluate trade-offs among generic resource types and the cumulative effects of adding various combinations of these resource to the existing system" (BPA 1992:S-2). The document "is intended to be broad enough to support Records of Decision for several Resource Programs" (BPA 1992:S-2).

The EA assumed a worst case load growth forecast to "identify maximum environmental effects" (BPA 1992:S-6). Resource acquisitions and operations were simulated by a model that built a "resource stack" that ordered resources according to least cost (BPA 1992:S-7). Thirteen alternatives were developed emphasizing different combinations of new resources to meet load growth requirements (BPA 1992:S-7). These included a No Action alternative that did not meet load growth requirements and allowed for increased efficiency in existing power plants, greater conservation, interregional exchanges of power, and fuel switching to wood and natural gas from electricity. The Status-quo alternative allowed for the addition of resources according to the 1990 Resource program using least cost planning, but environmental externalities would not be included in the planning process. The Base Case alternative is similar to the status-quo except that quantifiable environmental externalities are included in the planning process. The Base Case alternative was the standard against which BPA compared all other alternatives. The other alternatives involved "placing the available supply of the emphasized resource at the top of the stack of resources developed for the Base Case Alternative, after nondiscretionary conservation. (BPA 1992:S-8). Each of the alternatives emphasized one of the following power resources: high conservation, renewables, combustion turbines, coal, imports, clean coal, and fuel switching.

The effects of all alternative resources were determined both individually and cumulatively as part of the alternative. These included a wide range of effects from resource use or emissions from generation. Other impacts that were considered included social and economic effects, natural resource effects (e.g., reduced crop yields due to ozone emissions from fossil fuel combustion), cumulative impacts (in relation to additional energy resources), and the "irreversible or irretrievable commitment of resources" (BPA 1992:S-14).

Impact predictions were done using impact estimates developed in a previous utility research study.

Environmental externalities are evaluated by a selection process and included as part of the economic effects of each alternative. This selection process includes considering if an environmental effect produces a "change in an economic value" (BPA 1992:5-50). A determination is made as to whether a "meaningful economic analysis of the cost or benefit can be done and whether the costs or benefit can be adequately represented in monetary terms" (BPA 1992:5-50). The analysis involves considering several factors including: whether information exists to complete a "meaningful analysis", the costs and benefits that can influence the "cost-effectiveness of alternative resources", and "whether state and local standards significantly eliminate the environmental effect" (BPA 1992:5-50)

The main method used in this EIA for evaluation is the comparison of alternatives, through both table, graph and discussion.

The information that was used was not site specific and as with the Ontario Hydro analysis mentioned earlier "generic" data was used for power resource impacts. The load growth forecast would have been supplied from the BPA Demand/Supply plan. The analysis of the affected environment was not extremely detailed but did encompass a wide area (BPA's service area, and areas outside this area including to various degrees the states of California, Nevada, Montana, Wyoming, Arizona, Utah, New Mexico, and the province of British Columbia) and utilized previously available information.

Monitoring and mitigation were not explicitly mentioned in the EA, however mitigation measures required to meet regulatory guidelines were likely assumed for each alternative.

4.0 New Energy-Efficient Homes Program

The Bonneville Power Administration (BPA) also performed an EA of its New Energy Efficient Home Program. This DSM program is intended to promote building practices that increase the energy efficiency of homes but also has the potential to reduce indoor air quality if mitigation measures are not used. BPA produced an environmental impact statement with the objective of investigating whether different techniques could be used to maintain acceptable standards of indoor air quality in energy efficient homes (BPA 1988). Various different mitigation methods or "pathways" were created. One example of a pathway would be continuous mechanical ventilation, another would be continuous mechanical ventilation with a heat exchanger.

A baseline situation and a number of alternatives were created. The baseline assumed that no energy efficient new homes were being built. The no additional action alternative assumed energy efficient homes were built according to the existing BPA programs since 1985. The proposed action alternative included new energy efficient homes being built according to each of the different mitigation pathways indicated earlier. A preferred alternative included those energy efficient homes built according to a select group of pathways. These pathways were chosen according to health effects and flexibility. The final alternative was the environmentally preferred alternative, with the lowest impacts upon health and the environment.

The range of impacts included consideration of all environmental changes and impacts relating to the program alternatives. Indoor air pollution received the greatest attention as did the resultant health impacts. Other impacts that were considered included economic and social effects such as energy savings, costs to homeowners, fuel choices, housing affordability, employment, the housing industry, behavioral changes, institutional effects, and health and safety effects unrelated to interior air quality (e.g., CFC release from foam insulation). The avoided impacts of generation were also considered, these included the impacts avoided due to the reduced need for electricity and the resultant reduced need to, for example, burn fossil fuels to generate that electricity.

The prediction of impacts used generic impact estimates as well as air pollution and health impact models. Significance of impacts was determined through comparison of the impacts of alternatives.

The evaluation methods used in the EIS included the relative ranking of alternatives according to their impacts, as well as the comparison of alternatives through tables, graphs, and discussion. Information requirements for this assessment were considerable as indicated by the lengthy appendix, contributing studies, and a large number of contributors.

This method is flexible in the sense that it provides a framework that could produce an EA for many programs, however that EA would also require similar detail. The public is involved in this approach through its submission for public review and several public meetings in the region served by BPA. As part of the EIA a compilation of comments about the EIA and responses from the preparers was produced. In many cases the comments were acted upon and produced changes within the EIA. Mitigation and monitoring were inherent parts of each alternative.

5.0 Summary: EA Characteristics and Components (Table D1)

5.1 EA Characteristics

The EA approaches ranged from overall planning to consideration of a single program.

5.1.1 Placement in Planning Process

The EA examples occurred at different places in the planning process. The exact timing is difficult to infer from the documents, however if one considers the alternatives being considered, all but

Table D1: Summary of EA Characteristics and Components

	Utility Survey Results	Ten Year Programme Waste...	Supply Side Impacts	BPA Resource Programs	BPA Energy Efficient Home Program
Structure of approach	•Overall planning • Environ. externalities • Program • Issue orientated	Overall planning - national waste disposal	Overall planning - DSM programs	Overall planning - resource plan	DSM program planning
Placement in planning process	All levels - emphasis on later stages.	Early	Early	Early	Late
Objectives	• Impacts • Promote DSM programs • Other info.	Comparison of waste disposal alternatives. (solid waste)	Indirect impacts (supply side)	Evaluate tradeoffs among power resources	Comparison of mitigation alternatives (air quality)
Scoping		Wide range - national env. changes - cumulative	Wide range - regional - indirect env. changes - cumulative	Wide range - regional	Wide range - regional - focus on indoor air quality
Flexibility		• Non site specific	• Non site specific	• Non site specific. • Detailed	• Non site specific • Detailed
Alternative considered		Three - planning purposes	One - planning purposes	Many - power resources	Many - mitigation alternatives
Methods/ techniques used	• ad hoc committee • tabular comparison • cost-benefit • life cycle analysis	Alternatives Comparison - tabular - graphs - discussion	Alternatives Comparison - tabular - graphs - discussion	Alternatives Comparison - tabular - graphs - discussion	Alternatives Comparison - tabular - graphs - discussion ranking alt.
Resources required		Available data	Available data	Available data	Available data / other studies
Public	Public hearings	Interest groups	Public hearings	Public meetings	Public meetings

one (BPA's Energy Efficient Home Program EIA) was at an early stage in the planning process. Several of these were meant as documents that would guide further decisions in the future.

5.1.2 Objectives

The primary objective appears to be the evaluation of alternatives. The alternatives ranged from mitigation alternatives for interior air quality to waste management and utility power resource alternatives.

5.1.3 Flexibility

Each of these EA approaches were non-site specific and therefore can be applied in different regions. Several of these EAs were applied to a group of programs and as such have a wide application in terms of program type (eg., Ontario Hydro Supply Side EA). Other approaches such as the BPA Energy Efficient Home Program were focussed on mitigation alternatives and any further application would require a similar type of program.

5.1.4 Resources required

Pre-existing data was the primary source of information used to produce each EA.

5.2 Scoping

A wide range of impacts were considered in each EA. The study area was usually limited to the program area and in one case the area that is impacted (ie. BPA Power Resource Programs).

5.3 Impact identification

There was no indication of the methods used for identifying impacts.

5.4 Impact prediction

Generic impact estimates were used to varying degrees in each of these studies (e.g., Ontario Hydro study). The TPWM EA utilized environmental changes as a proxy for impacts. Ontario Hydro used environmental changes for similar reasons. Only the BPA Home Energy EIA ventured beyond the use of generic impact estimates through the use of air pollution and disease models.

5.5 Significance assessment

Impact significance was noted in relation to other alternatives and baseline conditions rather than regulatory standards. However, the use of environmental changes instead of impacts (ie. TPWM EA) will facilitate any determination of the regulatory significance of the environmental changes.

5.6 Evaluation of alternatives

The number of alternatives considered varied with the EA approach; when an alternative was only used for planning purposes there were fewer alternatives than when the alternatives were real options within a program or plan. The methods and techniques being used were primarily comparison of alternatives using graphs, tables, discussion and in one case ranking of the alternatives according to impacts.

5.7 Mitigation

The BPA Energy Efficient Home Program EIA evaluated various mitigation methods as program alternatives. Although none of the other EAs explicitly stated it, they likely assumed some mitigation measures as part of each alternative in order to meet regulatory requirements.

5.8 Monitoring

Only the the BPA Energy Efficient Home Program indicated monitoring would be done within the program. However, radon gas monitoring was not a direct result of the EA since it was an integral part of the program measures.

5.9 Public consultation

Some form of public involvement was included in each EA, although in none of these did the involvement appear to be extensive.

6.0 Conclusions

Several concepts stand out after looking at these environmental assessments. The TPWM EA employed a general form of sensitivity analysis when it evaluated its waste management alternatives with two different waste generation scenarios. Other than this example sensitivity analysis was not used in these EAs despite its obvious value in limiting the uncertainty of impact predictions.

Another feature of the TPWM EA and the Ontario Hydro Supply Side analysis was their use of environmental changes in place of environmental impacts. This reduced the complexity and resources required for each study. The use of generic impact estimates further simplified each of the assessments discussed above.

There were two distinct purposes for evaluating alternatives in the EAs discussed. The first was the use of alternatives for planning purposes and the other was the consideration of actual potential program alternatives.

Appendix E

Sample Survey Letters

1. Introductory letter

Jim Smith
Energy Management
Hudson Bay Power Corporation
34 West Rd.
Winnipeg, Manitoba
R3K 2G3

January 28, 1993

Dear Mr. Smith,

Demand side management (DSM) programs have been adopted by utilities as an "environmentally friendly" and "cost effective" alternative to the building of new generation facilities. However, no program avoids some form of impact. Utilities are experienced with traditional forms of "project" assessment but the assessment of "programs" is a relatively new development.

The questionnaire enclosed attempts to assess environmental assessments performed on energy conservation or DSM programs. The purpose of this survey is to help develop an ideal framework for the environmental assessment of DSM programs. For those utilities that have not attempted such assessments the questionnaire will seek reasons for the lack of assessment and opinions about performing assessments in the future. The information obtained through the survey will be used to complete a Masters practicum at the Natural Resources Institute, University of Manitoba, Canada. A summary of the results will be provided to respondents for their own use, and the completed practicum report will be available.

For your convenience, a self-addressed envelope is enclosed, and it would be appreciated if you would return the questionnaire, completed or not, by February 22, 1993. If the survey has not reached the appropriate person in your organization, please pass it on. The identity of respondents will be held in strict confidence.

If you require further information, please contact me at (204) 667-7414. Thank you in advance for your assistance,

Sincerely,

Jeffrey Turner

2. Follow-up letter

Jim Smith
Energy Management
Hudson Bay Power Corporation
34 West Rd.
Winnipeg, Manitoba
R3K 2G3

March 10, 1993

Dear Mr. Smith,

Response to my utility questionnaire regarding the environmental assessment of demand side management programs sent to you at the end of January has been interesting. Utilities in the United States, Europe, Canada, Australia, and New Zealand have provided information about how they conduct the environmental assessment of their DSM programs. While many have completed the questionnaire, others have found this difficult and have instead sent a letter that outlines their particular environmental assessment process or methodologies.

To date I have yet to receive any response from you. In order to develop conclusions about what type of assessment framework would be appropriate for DSM programs it would be helpful to obtain the widest sample of opinions and knowledge about the practices of utilities. If the questionnaire has already been mailed, I would like to thank you. If not, I would greatly appreciate it if you could send it as soon as possible to help me get a more complete view of this area of utility planning. Please feel free to send in only a partially completed questionnaire.

Sincerely,

Jeffrey Turner

Appendix F

Survey Recipients and Personal Communications

1. Utility Survey Recipients

Canada:

British Columbia Hydro, Vancouver, B.C.
Canadian Niagara Power Co. Ltd., Ft. Erie, ON
Coaticook Electric Dept., Coaticook, QU
Cornwall Electric, Cornwall, ON
Corp. of the District of Summerland, Summerland, BC
Edmonton Power, Edmonton, AB
Gananoque Light and Power Ltd., Gananoque, ON
Garton, Marvin - Market Development, Alberta Power Limited
Grand Forks Corp. Electric Dept., Grand Forks, BC
Great Lakes Power Ltd., Sault Ste Marie, ON
Hydro-Québec, Montréal, QU.
Hydro-Sherbrooke, Sherbrooke, QU
Joliette Municipal Utility, Joliette, QU
Jonquiere Electric Service, Jonquiere, QU
Kelowna Electric Dept., Kelowna, BC
La Ronge Region, La Ronge, SK
Lethbridge Electric System, Lethbridge, AB
Magog Electric Dept., Magog, QU
Maritime Electric Co. Limited, Charlottetown, P.E.I.
Medicine Hat Electric Utility, Medicine Hat, AB
Nelson Light Dept., 502 Vernon St., Nelson, BC
New Brunswick Power Corporation, Fredericton, NB.
New Wesminster Electric Dept., New Westminster, BC
Newfoundland & Labrador Hydro, St.John's, Newfoundland
Newfoundland Power, St.John's, Newfoundland
Northern Power Ltd., Creighton, SK

Northland Utilities Enterprises Limited, Hay River, NWT
Northwest Territories Power Corporation, Hay River, NWT
Nova Scotia Power Corporation, Halifax, Nova Scotia
Ontario Hydro, Toronto, ON
Penticton Corp. Public Works Dept./Elect. Div., Penticton, BC
Red Deer Electric: Light & Power Dept., Red Deer, AB
Saskatchewan Power Corporation, Regina, Saskatchewan
Saskatoon Electric Dept., Saskatoon, SK
Summerside Elec. Dept., Summerside, PEI
Swift Current Electric Department, Swift Current, SK.
TransAlta Utilities Corporation, Calgary, AB
Ville D'Alma, Alma, QU
West Kootenay Power and Light Co Ltd., Trail, B.C.
Westmount Light and Power Dept., Westmount, QU
Winnipeg Hydro, Winnipeg, MB
Yukon Electrical Company Limited, Whitehorse, Yukon

United States

Atlantic City Electric Co., Pleasantville, New Jersey
Austin Utilities, Austin, Texas
Black Hills Power and Light Co., Rapid City, South Dakota
Bonneville Power Administration, Portland, OR
Boston Edison, Boston, MA
Burlington Electrical Department, Burlington, VT
Central Hudson Gas and Electric Corp., Poughkeepsie, NY
Central Maine Power Co., Augusta, ME
Clark Public Utilities, Vancouver, WA
Consolidated Edison, New York, NY
Consumers Power Co., Jackson, MI
Detroit Edison Co., Detroit, MI
Duke Power Company, Charlotte, NC
Florida Power and Light, Miami, FL
Granite State Electric, Lebanon, NH
Illinois Power Co., Decatur, IL
Lakeland Dept. of Electric & Water Utilities, Lakeland, FL

Long Island Lighting Company, Hicksville, NY
Lower Colorado River Authority, Austin, TX,
Minnkota Power Cooperative, Grand Forks, ND
New England Electric System,. Westborough, MA
New York Power Authority, New York, NY
New York State Electric and Gas, NY
Niagra Mohawk Power Corp, Syracuse, NY
Northeast Utilities, Hartford, CT
Northern States Power Co., Minneapolis, MN
Ohio Edison Co., Akron, OH,
Orange and Rockland, Pearl River, NY
Pacific Gas and Electric Co, San Francisco, CA
Pacific Power and Light, Portland, OR
Portland General Electric Co., Portland, OR
Potomac Electric Power Co., Washington, D.C.
Public Service Co of Colorado, Denver, CO
Puget Sound Power and Light Co., Bellevue, WA
Rochester Gas & Electric Corp, Rochester, NY
San Diego Gas & Electric Co., San Diego, CA
Seattle City Light, Seattle, WA
Southern California Edison Company, Long Beach, CA
Tacoma Public Utilities - Light Div., Tacoma, WA
Tampa Electric, Tampa, FL
Taunton Municipal Lighting Plant, Taunton, MA
Tennessee Valley Authority, Chatanooga, TN
The Narraganset Electric Co., Providence, RI
United Illuminating Co., New Haven, CT
Virginia Electric and Power Co., Richmond, VA
Wisconsin Electric Power Co., Milwaukee, WI

Other

ACT Electricity & Water Authority, Canberra City, Australia
Badenwerk AG, Karlsruhel, Germany
Balernwek AG, Munchen , Germany
Berliner Kraft - und Licht AG, Berlin , Germany

Centralschweizerische Kraftwerke CKW, Lucerne, Switzerland
Danske Elvaerkers Forening, Fredriksberg C, Denmark
East Midlands Electricity plc, Arnold, Nottingham, United Kingdom
Eastern Electricity plc, Wherstead, Ipswich, United Kingdom
Electrabel, Bruxelles, Belgium
Electriciteitsbedrijf Zuid-Holland NV (EZH), Voorburg, Netherlands
Electricity Corp. of New Zealand Ltd., Wellington, New Zealand
Electricity supply board, Dublin, Republic. of Ireland
Electricity Trust of South Australia, Eastwood, S. Australia, Australia
Elektrizitätswerk Der Stadt Zürich EWZ, Zurich , Switzerland
Elektrizitätswerke Des Kanton Zürich EKZ, Zürich, Switzerland
Elkraft Power Company Ltd., Ballerup, Denmark
Energie Versorgung Schwaben, Stuttgart , Germany
Gemeente-Energiebedrijf, Amsterdam, Netherlands
Hamburgische Electricitats - Werke AG, Hamburg 60, Germany
Københavns Belyningsvaesen, København K, Denmark
London Electricity plc, , London, United Kingdom
Manweb plc, Sealand Rd., Chester, CH1 4LR, United Kingdom
Midlands Electricity plc, Halesowen, West Midlands, United Kingdom
Midtkraft Interessentskabet, Aarhus C, Denmark
National Grid Company Plc, London, United Kingdom
National Power Plc, London, United Kingdom
NESA A/S, Hellerup, Denmark
Nordostschweizerische Kraftwerke AG (NOK), Baden, Switzerland
Northern Electric Plc, Newcastle upon Tyne, United Kingdom
Northern Ireland Electricity, Belfast, United Kingdom
Northern Territory Power and Water Authority, Darwin, Northern Territory, Australia
Norweb Plc, Manchester, United Kingdom
Nuclear Electric Plc, Barnwood, Gloucester, United Kingdom
NV Samenwerkende Elektriciteits-produktiebedrijven, Arnhem, Netherlands
PGEM Energiemaatschappij VVoor Gelderland En Fleveoland, Arnhem, Netherlands
Power Gen plc, Shirley, Solihull West Midlands, United Kingdom
Preussen Elektra AG, Hannover , Germany

Provinciale Limburgse Elektriciteits-Maatschappij (NV), Maastricht, Netherlands
Provinciale Noord Brabantse Energie-MIJ NV (PNEM), s'Hertogenbosch, Netherlands
Queensland Electricity Commission, Brisbane, Queensland, Australia
Rheinisch - Westfalisches Elekrizitatswerk AG, Essen, Germany
Scottish Hydro-Electric Plc, Edinburgh, United Kingdom
Scottish Nuclear Ltd., Glasgow, United Kingdom
Scottish Power Plc, Glasgow, United Kingdom
Seeboard Plc, Hove, East Sussex, United Kingdom
Services Industriels De Genève SA, Service de l'életricité, Genève, Switzerland
Services Industriels De la Ville De Lausanne, Lausanne, Switzerland
Snowy Mountains Hydro-Electric Authority, Cooma, New South Wales, Australia
South East Queensland Electricity Board, Brisbane, Australia
South Wales Electricity Plc, St. Mellows, Cardiff, United Kingdom
Southern Electric Plc, Maidenhead, Berkshire, United Kingdom
Southwestern Electricity Plc, Almondsbury, Avon, United Kingdom
State Electricity Commision of Victoria, Melbourne, Victoria, Australia
State Energy Commission of Western Australia, Perth, Western Australia, Australia.
Statkraft, Oslo, Norway
Stockholm Energi Produktion AB, Tuleg, Stockholm, Sweden
Sydkraft AB, Malmoe, Sweden
The Electricity Commission of New South Wales, Sydney, Wales, Australia
The Hydro-Electric Commission, Hobart, Tasmania, Australia
Vattenfall, Välingby, Sweden
Vereinigte Elektrizitatswerke Westfalen AG, Dortmund, Germany
Yorkshire Electricity Group Plc, Scarecroft, Leeds, United Kingdom

2. Personal Communications

Environmental assessment of DSM programs.

Akerstream, Tom. Energy Management, Manitoba Hydro. Personal communication. March 1993, April 19 1993.

Blouin, Tony. Director, Environmental Assessment, Environment Branch, Newfoundland Department of Environment & Lands, Government of Newfoundland. Personal communication. April 8, 1993.

DePape Denis. Senior Policy Analyst, Environmental Policy and Planning Dept., Manitoba Hydro. Personal communication. March 1993.

Doyle, Derek. Director, Environmental Assessment Branch, Environmental Planning & Protection Division, Ministry of the Environment, Government of Ontario. Personal communication. March 24, 1993.

Dryden, D.W. Director, Environmental Assessment Branch, Ministry of Environment, Land & Parks, Government of British Columbia. Personal communication. March 1993.

Environmental Impact Assessment Department, Dept. of the Arts, Sport, the Environment,Tourism, and Territories. Personal communication. Canberra, ACT, Australia. 1993.

Environmental Impact Assessment Department, Minister of Housing, Physical Planning and the Environment. Personal communication. The Hague, Netherlands. 1993.

Environmental Impact Assessment Department, Ministry of the Environment and Natural Resources. Personal communication. Tegelbacken, Stockholm, Sweden. 1993.

Environmental Impact Assessment Department, Ministry of the Environment. Personal communication. Oslo, Norway. 1993.

Environmental Impact Assessment Department, Ministry of the Environment. Personal communication. Wellington, New Zealand. 1993.

Gordon, Kirk. Manager, Environmental Impact Assessment Section, Environmental Planning & Sciences, New Brunswick Department of the Environment. Personal communication. April 8, 1993.

Hamlin, Bill. Generation Planning, Manitoba Hydro. Personal communications. March 23,1993, March 30, 1993, September 7, 1993.

Henningsen, Jørgen. Directorate B - Environment, Nuclear Safety and Civil Protection. Commission of the European Communities. Personal communication. Bruxelles, Belgium. 1993.

La Voie, André. Director, Policy and Assessment Coordination, Department of Community and Cultural Affairs, Government of Prince Edward Island. Personal communication. March 1993.

Moline, Barry J. 1993. Manager Demand-Side Programs, American Public Power Association. Personal communication. 1993.

Moroz, Tracy. Energy Management, Manitoba Hydro. Personal communication. March 1993, May 1993.

Pagé, Yves L. Director, Environmental Assessments, Agricultural & Natural Resources, Ministry of Environment, Government of Québec. Personal communication. March 1993.

Porter, Rob. Director, Environmental Support Services Division, Nova Scotia Department of Environment, Government of Nova Scotia. Personal communication. April 8, 1993.

Schulte, Fred. Director, Environmental Assessment, Environmental Protection Branch, Alberta Environment, Government of Alberta. Personal communication. March 1993.

Strachan, Larry. Director, Environmental Approvals Branch, Environmental Management Division, Manitoba Environment, Government of Manitoba. Personal communication. April 8, 1993.

Zukowsky, R.J. Director, Environmental Assessment Branch, Planning and Assessment Division, Saskatchewan Environment & Public Safety, Government of Saskatchewan. Personal communication. March 1993.

Management of mercury containing lamps and PCB ballast waste

Alberta Special Waste Management Corporation. Personal communication. Edmonton, AB, April 1993.

B.C. Environment, Lands and Parks. Government of British Columbia. Personal communication. Victoria, B.C., April 14 1993.

Beyzak, Dave. Manitoba Environment. Government of Manitoba. Personal communication. Winnipeg, Manitoba, May 1993.

Dion, T. 1993. Personal communication. May 1993.

Dyck, Harold. Workplace Safety and Health. Manitoba Environment. Government of Manitoba. Personal communication. Winnipeg, Manitoba, May 1993.

Edigier, Dave. Manitoba Environment. Personal communication. April 1993.

Edmunds, Ross. Manitoba Hazardous Waste Corporation. Personal communication. Winnipeg, Manitoba, March 1993.

Electrical and Electronic Manufacturers Association of Canada. Personal communication. Ottawa, Ontario. 1993.

Fong, Mark. California Solid Waste Management Board. Personal communication. Sacramento, CA, U.S.A., April 13, 1993.

Fraser, Wayne. Hudson Bay Mining and Smelting. Personal communication. Flin Flon, Manitoba, May 1993.

Hazardous Waste Department, Minister of Housing, Physical Planning and the Environment. Personal communication. The Hague, Netherlands. 1993.

Hazardous Waste Department, Ministry of the Environment and Natural Resources. Personal communication. Stockholm, Sweden. 1993.

Hazardous Waste Department, Ministry of the Environment. Personal communication. Oslo, Norway. 1993.

Jansen, Jim. Hazardous Contaminants Branch, Ontario Environment Department. Government of Ontario. Personal communication. Toronto, ON, March 31, 1993.

Kemp, Rob. Alberta Environment Dept. Personal communication. April 14, 1993.

Leyland, David. U.S. E.P.A. Personal communication. Washington D.C. December 1992.

McKormik, Rod. Manager. Waste Reduction & Prevention Branch. Manitoba Environment. Government of Manitoba. Personal communication. March 1993

Murillo-Matilla, Eusebio. Directorate A - Environment, Nuclear Safety and Civil Protection Commission of the European Communities. Personal communication. Bruxelles, Belgium. 1993.

Myslicki, John. Chief. Hazardous Waste Management Division. Environmental Protection Directorate. Environment Canada. Government of Canada. Personal communication. Hull, Quebec, April 22, 1993.

National Electric Manufacturers Association (NEMA), Personal communication. Washington D.C., U.S.A. 1993.

Nichols, Eric. California State Department of Toxics. Personal communication. April 1993.

Olson, Terry. SYLVANIA Lighting - GTE. Personal communication. Danvers, MA, U.S.A. 1993.

Pastor, Linda M. Manager, Market Development. General Electric Company. Personal communication. Cleveland, Ohio, U.S.A. March 8, 1993.

Peterson, Paula. Minnesota Pollution Control Agency, Hazardous Waste Division. Personal communication. St. Paul, Minnesota, U.S.A. 1993.

Schmitt, Dr. Michael C.F. President. OSRAM Canada Limited. Personal communication. Mississauga, Ontario, February 10, 1993.

Wasny, Paul. 1992. Electrical Systems Engineer. Energy Management. Program Development. Manitoba Hydro. Manitoba Hydro Inter-Office Memorandum. Subject: Disposition of Scrap & Hazardous Materials From Power Smart Lighting Program Participants. July 28, 1992.

Wasny, Paul. Electrical Systems Engineer. Energy Management. Program Development. Manitoba Hydro. Personal communication. 1993.

Wolnack, Chris. Ontario Waste Management Corporation. Personal communication. Toronto, Ontario, March 25, 1993.

Zalinski, Al. March 1993. General Electric Company. Personal communication. Cleveland, Ohio, U.S.A.

Appendix G

Trial EA of Manitoba Hydro's Energy Efficient Lighting Program

1. Limitations of Trial

The selective DSM EA framework will be applied to Manitoba Hydro's Energy Efficient Lighting Program. For this trial only the first stage will be completed. This dictates that the two main objectives of this EA are to evaluate the environmental changes of the program and to identify possible mitigation measures.

There are two main impacts related to the installation of energy efficient lighting equipment. The first is the release of mercury that is contained in several widely used lighting systems. The next is the release of PCBs that are contained in the ballast of fluorescent and mercury vapour lamps; this only applies to those lamps/ballasts installed prior to 1978. This EA will focus on the release of mercury; this is more likely to be a continuing problem since mercury has no available substitute at present. The EA will be restricted to the 10 year period of the program, although impacts will continue to occur from equipment installed under the program.

2. Scope

The EA will apply to Manitoba Hydro's Energy Efficient Lighting Program. The programs area of application will include the whole service area of both Manitoba Hydro and Winnipeg Hydro: together these service areas include the whole province. Winnipeg Hydro's service area has been included for logistical reasons. Baseline data for the sales of mercury containing lamps is only available for the whole province and the two service areas have different characteristics (e.g., Industry/Residential customers). Another reason is that Winnipeg Hydro may either adopt the same program or the promotional effects of the Manitoba Hydro program will influence Winnipeg Hydro customers consumer behavior. The program lifespan of ten years will be used as the length of the study period.

3. Description of Alternatives

Two alternatives will be considered: the number of fluorescent lamps being used in the province over the next ten years with the program and without the program. The basis for choosing these two alternatives rests with the objectives of the first stage of this EA. These are to evaluate the environmental changes from the program and to identify possible mitigation measures. Consideration of other alternatives is not useful since this would not help achieve the main objectives.

4. Identification of Impacts

4.1 Mercury

Knowing the quantities of mercury released into the environment is important because of its chemical and physical properties, toxic characteristics, and its ability to bio-accumulate in the food chain. There are several forms of mercury, some of these are inorganic and others organic.

Elemental mercury is an inorganic form of mercury. Elemental mercury is relatively rare in nature with the mercurous ion (Hg_2^{+2}) and the mercuric ion (Hg^{+2}) more common (NRCC 1979:29). At room temperature elemental mercury is a volatile liquid metal. At 20 degrees Celsius mercury droplets will evaporate at a rate of 5.8 μg/hr cm^{-2} and air is saturated at 13 mg/m^3 (Magos 1988). Mercury can form inorganic salts and can also combine with organic acids (Magos 1988). Methylmercury compounds are organic forms of mercury produced by bacteria.

4.2 Mercury's Health Effects

Magos (1988) notes that the symptoms of exposure to high concentrations (> 2.0 mg/m^3) include acute pneumonitis (chest tightness, dyspnea, and paroxysmal cough). Higher levels of exposure can produce symptoms of chronic mercurialism. These include intention tremor, abnormal emotionality, salivation, gingivitis (gum inflamation), and in some cases proteinuria (kidney condition). He notes that inorganic mercury salts can have a corrosive effect on both the skin and when ingested, the gastrointestinal tract. Later effects from ingestion include oliguria and acute renal failure. The primary location of damage from the ingestion of methylmercury is the central nervous system. Symptoms begin with "paresthesia [burning or prickling sensation] and the first clinical sign is ataxia [lack of coordination] followed in severe cases by the constriction of the visual field, dysarthria [speech disturbance due to nerve damage], and deafness" (1988:425). He also notes that methylmercury and other forms of organic mercury can have a corrosive effect on the skin (Magos 1988). Methylmercury can accumulate within the food chain and for this reason it can become a serious health threat to people (NRCC 1979).

4.3 Mercury Impacts Upon Environmental Components

There are two key areas where mercury may produce impacts upon environmental components beyond those impacts on human health; these include impacts upon soil and water biology.

In terms of soil biology mercury is a toxic substance that may have a significant impact upon the "metabolic processes in soils and on the structure of organism communities, even where the degree of contamination is relatively low" (SEPA 1991: 13). Estimates of the concentration levels of mercury in soil that should be of concern range from 0.4 to 0.5 mg/kg for mineral soils (SEPA 1991).

The impact upon water biology is quite different since the bioaccumulation characteristics of mercury allow it to pass through the whole trophic layer of a stream, lake or ocean with increasing concentration within organisms (Figure G1). Inorganic mercury (usually the ionic form) is converted to organic methylmercury by microbes through a process called methylation (Canada-Manitoba 1987). This is a two-way process with microbes involved in both methylation and demethylation. The net product of this process is methylmercury or "bio-available" mercury (Canada-Manitoba 1987:68-69). The process by which the methylmercury enters the

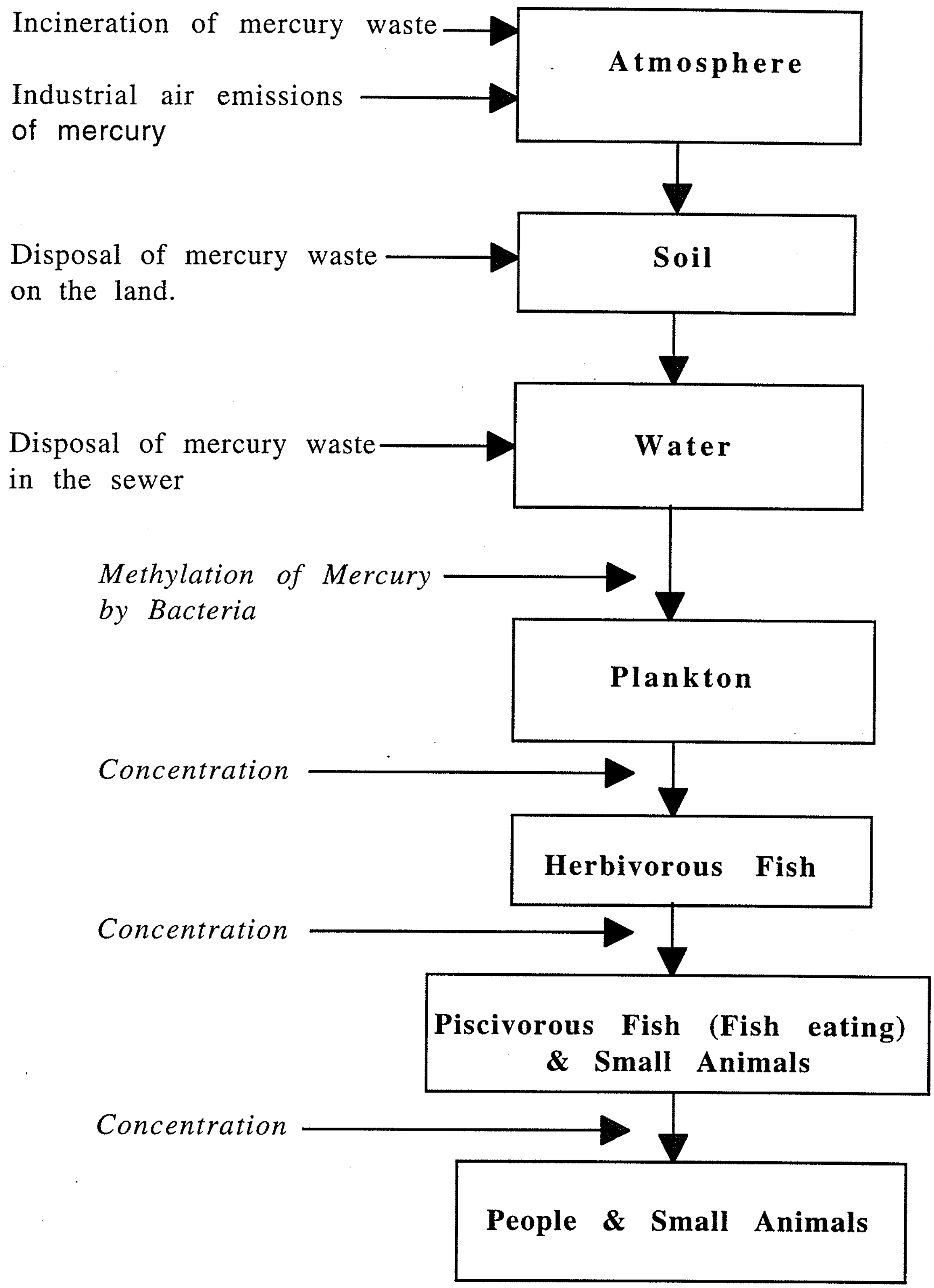

Fig. G1 Bioaccumulation of mercury - anthropogenic sources (Eutrotech 1991:33) fish is one of debate: mercury either enters the fish through food or via the gills directly from the water (Canada-Manitoba 1987).

Mercury levels in fish within the same body of water vary with the species, piscivorous species (e.g., Northern Pike, Walleye, and Sauger) having considerably higher levels of mercury than non-pisciviorous (e.g., Whitefish, Goldeye) (Canada-Manitoba 1987). Reasons that have been forwarded to explain this discrepancy include differences in diet and habitat preference (Canada-Manitoba 1987).

Mercury poisoning can also occur in animals that consume fish with high quantities of mercury. This is the case with humans, with high levels of mercury producing damage to the nervous system before and after birth (Canada-Manitoba 1987). Mercury poisoning becomes especially serious in cultures where fish provides a large portion of the protein needs. The damage to adults is mainly in the central nervous system where symptoms include lack of coordination and speech impairment, among others. When exposure occurs during the fetal stage, effects include delayed motor and intellectual development (Canada-Manitoba 1987).

Researchers in Sweden consider there to be a significant connection between increased levels of mercury in fish, the transport of mercury into lakes (aerial deposition and direct discharge) and the acidification of lake water (SEPA 1991). Northern Manitoba has experienced elevated levels of mercury in biota from lakes and rivers that have been diverted or impounded as part of hydro-electric developments (eg., South Indian Lake as part of the Churchill River diversion). These elevated levels of mercury are argued to have a different cause than those observed in Sweden. Mercury deposition in lake sediment has been observed to be increasing in the last century at the global rate (Bodaly, Hecky, Fudge 1984). Agricultural and industrial sources have been largely discounted as causes, and the likelihood of a geological formation being the source of mercury is considered possible, but unlikely (Bodaly, Hecky, Fudge 1984). Instead, the increased mercury levels likely result from the bacterial methylation of mercury found in flooded soils (Bodaly, Hecky, Fudge 1984).

4.4 Pathways of Lamp Mercury

4.4.1 Waste Pickup and Disposal

Fluorescent and high intensity discharge (HID) lamps contain mercury as an ionizing agent within the evacuated vessel that generates the light. Mercury is released only if the lamp is broken. The mercury that has not combined with the phosphor, glass or metal components of the lamp can be released into the surrounding air. In addition to accidental breakage during installation, operation, or replacement the lamp could be broken when it is picked up by waste disposal trucks or when the waste is dumped and crushed in the waste disposal site (Figure G2). Upon breaking the glass vessel some of the mercury will immediately be released into the air while some will remain in the waste (MOWM 1993). The mercury not immediately released into the air may remain where it is, it may be "attenuated" by the surrounding waste and soils, it may reach the groundwater or a leachate collection system, or it may reach the

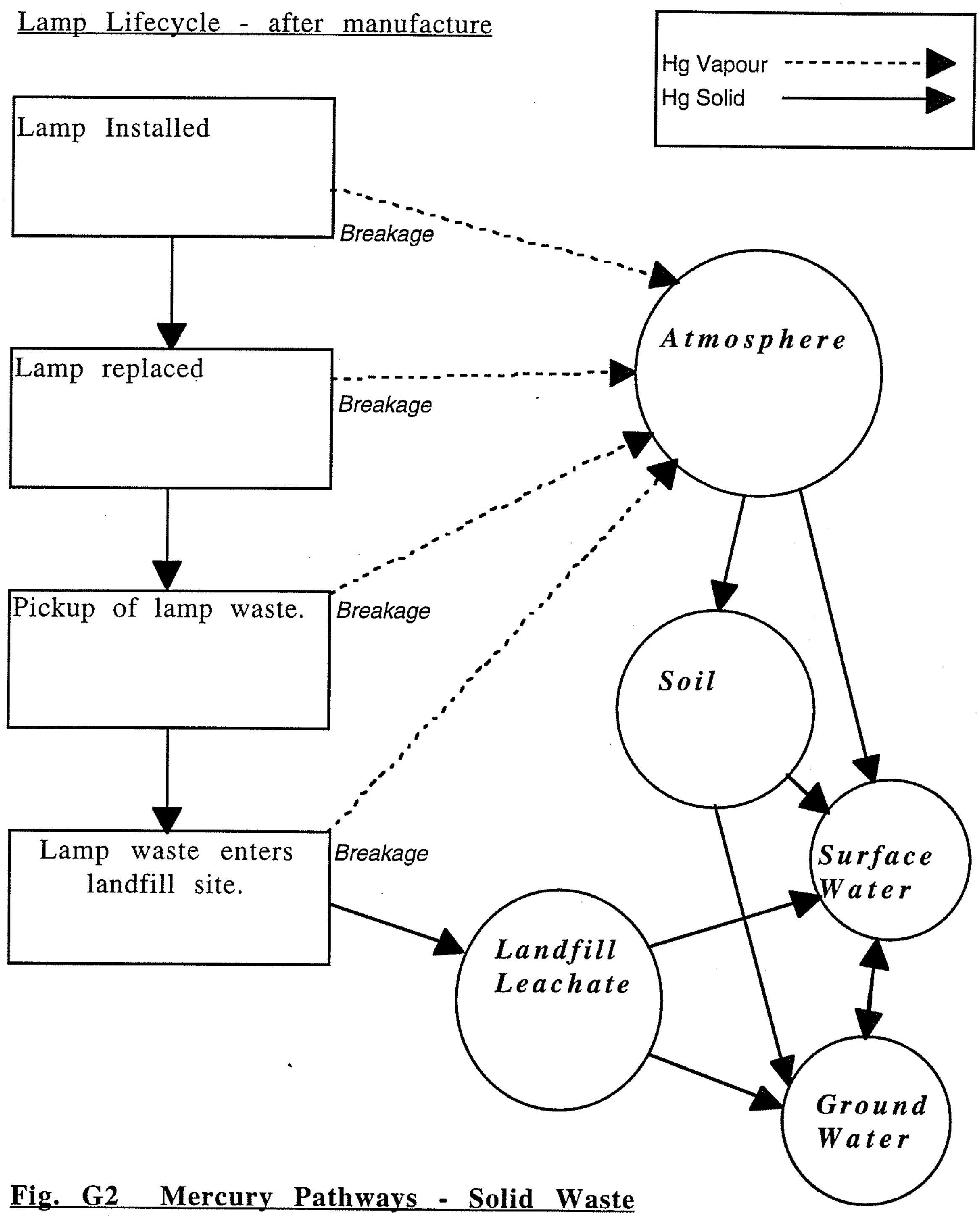

Fig. G2 Mercury Pathways - Solid Waste

atmosphere (MOWM 1993:19). Mercury is known to have relatively poor leaching characteristics thus limiting this transport pathway (MOWM 1993). One estimate suggests that approximately half of the mercury is released to the air at the time a lamp is discarded (MOWM 1993). Once lamp waste is placed in the landfill some of the mercury evaporates (MOWM 1993). Concentrations of mercury in landfill leachate in the U.S. has been found to be highly variable (MOWM 1993).

If waste is sent to an incinerator rather than a landfill the pathways are different. Here the waste would again have an opportunity to be crushed when it is handled at the incinerator. Depending upon the level of pollution control equipment installed at the incinerator a large portion of the mercury will reach the atmosphere after waste combustion.

The Swedish Environmental Protection Agency or SEPA (1991) describes the fate of mercury released from solid waste incinerators into the environment. There are two different forms of mercury: elemental and ionic. Where no treatment processes are used 20-60% of emissions are released in the ionic form which is usually bound to particles. The remaining portion of mercury is released as elemental mercury. Elemental mercury can be transformed into ionic mercury through entrapment by particles and water droplets. The retention time in the atmosphere for these two types of mercury vary from days or weeks for ionic mercury to months or years for elemental mercury. The length of time that they reside in the atmosphere suggests that deposition to the surface can occur several thousand kilometers from the emission site for ionic mercury to a global distribution for elemental mercury (SEPA 1991).

They note that mercury is deposited to the ground either with or without precipitation. The proportion of the two is unknown at present. Once mercury reaches the surface it is "quickly bound to the organic matter in the upper layer of the soil (humus layer) (SEPA 1991:18). A cross-section of soil layers would show that most of the mercury deposited this century is bound to particles in the humus layer. Fixing rates for mercury in the humus layer of some regions of Sweden are 80% of precipitated mercury. Most of the mercury found in deeper layers (more than 20 - 30 cm.) is likely natural in origin. The concentration of mercury in the humus layer varies in relation to the depth of that layer, thinner layers will have higher concentrations and vice-versa (SEPA 1991).

Mercury can reach water directly through precipitation or indirectly through precipitation water that flows through soil where it "dissolves and carries humus into watercourses" (SEPA 1991:19). The amount of mercury that reaches watercourses depends upon the type of soil and the flow characteristics of the water, in addition to other factors (SEPA 1991). As mentioned earlier, the levels of water acidity do not significantly influence the leaching rate of mercury (MOWM 1990, SEPA 1991). Areas that have thin soils and no wetlands have the largest quantities of mercury in ground-water (SEPA 1991). During spring when the water table is high and transport in the soil is in the upper 50 cm. of the soil the greatest amount of mercury is transported to streams (SEPA 1991). A mercury budget for an average lake area in southern Sweden indicates that the deposition of mercury from the atmosphere to the land is ten times greater than its loss through leaching into watercourses. This suggests that mercury accumulation continues and so does the transport of mercury to the water (SEPA 1991). The increase in transport to water is slow because the quantity of mercury in soil is nearly 1000 times the amount that is leached out by drainage water (SEPA 1991).

Not only freshwater is influenced by the release of mercury into the environment. Eventually the water reaches the ocean where it also can prove detrimental although it is diluted, lessening the problem.

The fate of mercury deposited with solid waste in landfills is different. At landfills mercury containing waste is deposited relatively deeper than mercury collecting on the soil surface from the air. Furthermore the process of placing waste in landfills involves the compaction of waste that would reduce the leaching of mercury contained in that waste. Finally, landfills are usually designed to prevent the easy transfer of contaminants through leaching. Either a location is chosen with soil types not conducive to leaching (e.g., clay layer) or such a layer is created (e.g., clay or plastic barrier). Therefore the fate of mercury in landfills is quite different from air precipitates.

5. Impact Prediction

5.1 Assumptions

The Energy Efficient Lighting Program is expected to accelerate a technology change that was already occurring; energy efficient lighting products have been available for a couple of years. Although they are cost-effective, the high initial purchase price of this equipment has limited their use. One exception is the construction of new buildings, where designers have been introducing these systems more rapidly. The number of lamps entering the waste stream can be estimated by determining the sales of lamps (MOWM 1993, NEMA October 1992). In reality there is a lag of several years before an installed lamp is discarded and becomes waste but the effect would have a limited influence on the results (ie. overestimating discards). For the purpose of this study purchased lamps will be equated to disposed lamps.

The lamp discard rate of change can be broken down into two components. There is a baseline discard rate of change that occurs without the program and a program related discard rate of change. For the purposes of this EA trial the program will be assumed to contribute to a 2% per year increase in the discard of fluorescent lamps in the first two years and a 4% per year increase thereafter for the length of the program. No increase in the use of HID lamps is attributed to the program since the sales of these lamps have been influenced by pre-existing DSM programs; no additional increase is anticipated beyond the baseline discard rate.

The baseline discard rate of change for Canada was determined to be an increase of 5.93% per year for fluorescent lamps and 7.58% per year for HID lamps.[1]

Projections of lamp discards for Canada are calculated by applying the baseline discard rate of change to the last available year of Statistics Canada data (1992 for fluorescent lamps, 1989 for HID lamps). The process is repeated for each year of the projection period using the last projection and the baseline discard rate of change. Projections of lamp discards in Canada are made for each year from 1993 to 2002 for fluorescent lamps and 1990 to 2002 for HID lamps.

Lamp discards and the projections of lamp discards for Canada are converted to per-capita form using census and projected demographic data (Appendix 2).

Lamp discard projections for Manitoba are calculated by taking the product of four variables, the per-capita fluorescent lamp discards for Canada, the population of Manitoba (Appendix 2), the baseline discard rate coefficient[2], and the program discard coefficient[3] for that particular year.

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1 The baseline discard rate for lamps has been calculated for both types of lamp by determining the mean of the annual rates of change for each year over a specific interval of time. For fluorescent lamps data for the period 1982 to 1990 was used. Because Statistics Canada changed its category for HID lamps from 1990 onwards, the data period for these lamps is restricted to 1982 to 1989. Data from (Statistics Canada 1983-1993).

2 The baseline discard rate coefficients are 1.0593 and 1.0758 derived from the baseline discard rate of change of 5.93% per year for fluorescent lamps and 7.58% per year for HID lamps, respectively.

3 In the case of this trial the coefficients for fluorescent lamps are 1.02 and 1.04 derived from the predetermined program discard rates of change of 2% per year (1993-1994) and 4% per year (1995-2002), respectively. For HID lamps a coefficient of 1.0 is derived from the 0% per year program discard rate of change for these lamps. For the no program trial the same procedure is

The amount of mercury contained in the lamps is variable throughout the actual and projection period. Manufacturers of lamps have and are expected to continue to reduce the amount of mercury in the lamps. Estimates for the periods 1970-1984 and 1985-1992 (Table G3) were obtained from the U.S. National Electrical Manufacturers Association (NEMA) and applied to a largely similar period of years (1982-1990). It is assumed that source reduction will continue but at a decreasing rate due to the limitations presented by lighting technology (NEMA October 1992). Projections from the same industry association indicated that source reduction would reduce mercury in fluorescent lamps to 27.0 mg by the year 1995. The projected values for mercury content for both types of lamps are conservative interpretations of the mercury reductions expected by the industry association. No comparable projection of source reduction was available for HID lamps, consequently these values are likely more inaccurate estimates.

5.2 Baseline - Environmental Changes/Impacts Without the Program.

5.2.1 Other Sources and Activities.

There are a number of other natural and anthropogenic sources of mercury in the environment.

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used, however the coefficient will be 1.0 for both lamps derived from a 0% per year program discard rate of change for the same period of time.

5.2.1.1 Natural Sources of Mercury

There are several natural sources of mercury. Some of the major ones include volcanic emissions, forest fires, and soil erosion. Estimates of the quantity of mercury released annually vary and are uncertain (Slemr & Langer 1992). A recent estimate suggests that natural sources may represent only 40% of total emissions and that higher estimates may have overestimated emissions from geothermal sources (Slemr & Langer 1992).

5.2.1.2 Anthropogenic Sources of Mercury

From a global perspective the concentration of mercury in the atmosphere appears to be increasing at a rate of 1.17 % per year in the southern hemisphere to 1.46 % per year in the northern hemisphere (Slemr & Langer 1992). Slemr and Langer (1992) attribute this trend to increases in anthropogenic activities. They note that measurements of mercury strata in soil, peat, bog and sediment indicate an increase of deposition from the atmosphere by a factor of 0.5 to 5.1 since the beginning of the 19th century.

The quantities of mercury from human sources has changed as technology was developed to reduce a major source of anthropogenic mercury release, the production of caustic soda by chlor-alkali plants. These facilities underwent technological changes in the 1970s that reduced their mercury emissions significantly and placed their portion of the mercury load in Canada to under three percent, which is below that of thermometers (Eutrotech 1991). There are no chlor-alkali facilities in Manitoba but industry remains a major source of mercury emissions.

In Manitoba the major source of mercury emissions is from the mining and smelting industry, followed by paint emissions and batteries (Table G1, Figure G3).

If only the solid waste stream in Manitoba is considered it is apparent that the emissions of mercury are primarily from used batteries; as recycling and source reduction of mercury in these batteries occurs the emissions are expected to be reduced considerably (Table G2, Figure G4). In terms of all anthropogenic emissions a decline is expected from the emission of mercury from paint as mercury's use is discontinued or reduced.

5.2.2 Similar Activities or Sources

Fluorescent lamps have been used for years and are routinely discarded in both small quantities (e.g., Homeowners) and large quantities (e.g., Building Maintenance Personnel). Although HID lamps have also been around for a number of years they are not used as often by the public and are sometimes stored instead of disposed of as solid waste.

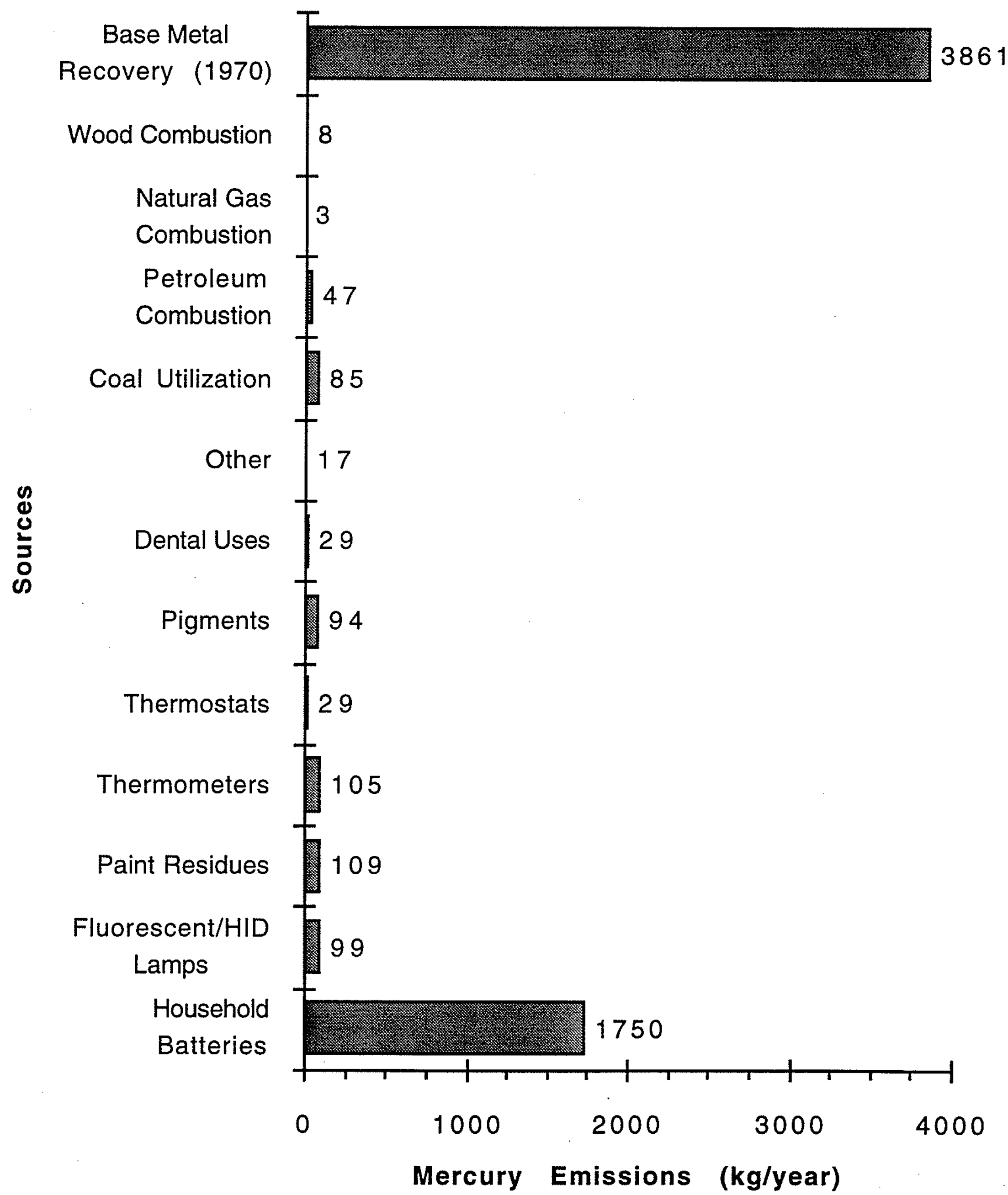
The emissions of mercury from the discard of fluorescent and HID lamps are projected to decrease over the next few years due to the decreasing amount of mercury in the lamps even though the

Table G1: Mercury emissions 1978-1980 (Manitoba)

Products	Year 1980	% Total Municipal Solid Waste Emissions	% Total All Emissions
Household Batteries	1750.42	78.45%	28.07%
Fluorescent/H.I.D. Lamps	99.03	4.44%	1.59%
Paint Residues	108.82	4.88%	1.75%
Thermometers	104.74	4.69%	1.68%
Thermostats	28.53	1.28%	0.46%
Pigments	93.74	4.20%	1.50%
Dental Uses	28.94	1.30%	0.46%
Other	17.12	0.77%	0.27%
Subtotal	2231.33	100.00%	
Other Anthropogenic Emissions	**Year 1978**		
Coal Utilization	85		1.36%
Petroleum Combustion	47		0.75%
Natural Gas Combustion	3		0.05%
Wood Combustion	8		0.13%
Base Metal Recovery (1970)	3861		61.92%
Subtotal	4004		
Total	6235.33		100.00%

Source: *Discards of mercury in products in the municipal solid waste stream were obtained from* Table G2. *All other data was obtained from* Sheffield, Arthur. Air Pollution Control Directorate. Environment Canada. 1983. National Inventory of Sources and Emissions of Mercury (1978) Economic and Technical Review Report EPS 3-AP-81-1. Ottawa: Minister of Supply and Services, 1983.

Fig. G3: Anthropogenic Mercury Emissions - Manitoba 1980



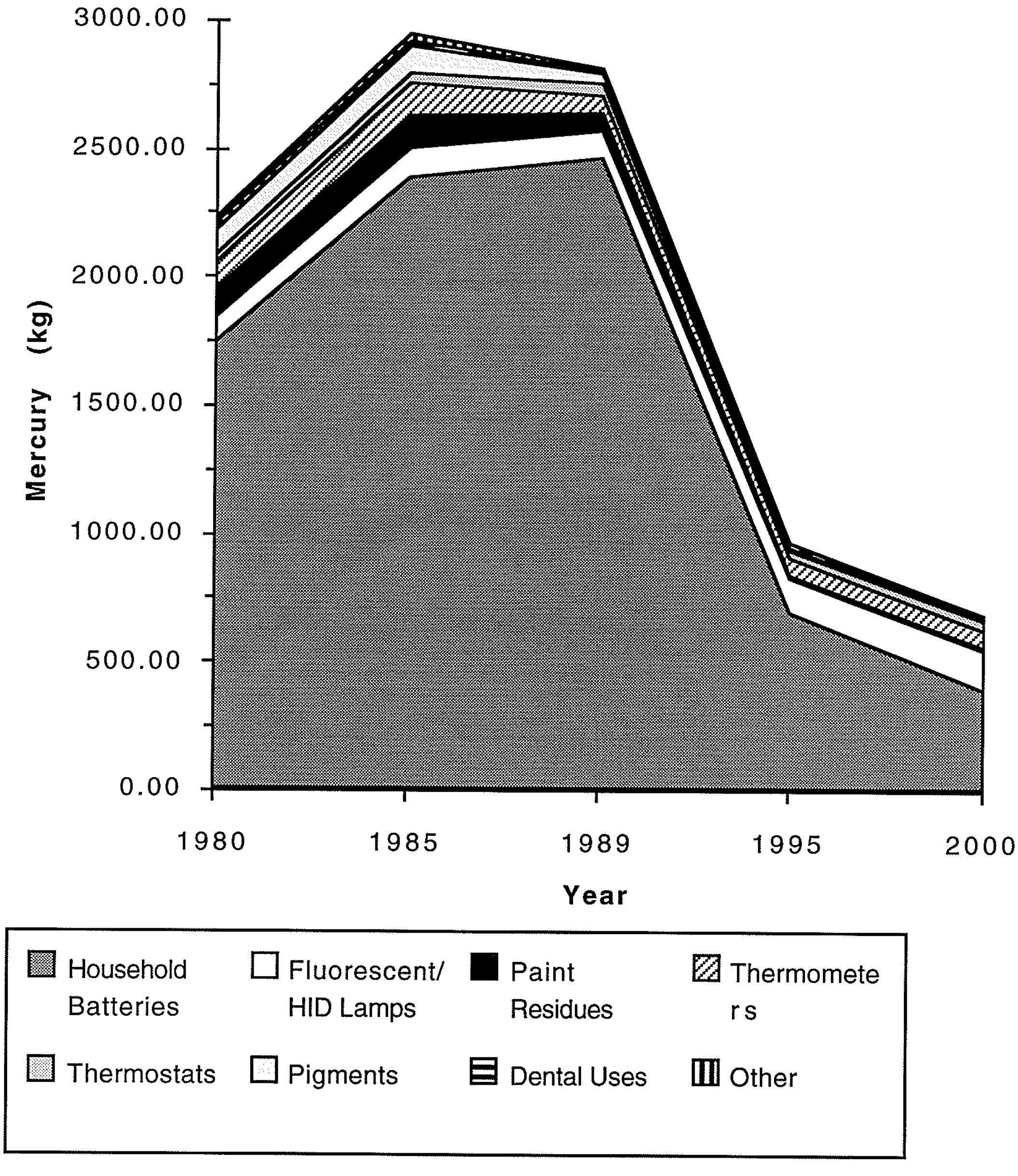
Source: Table G1

Table G2: Mercury in the Manitoba Solid Waste Stream 1980 - 2000

Product	Mercury Emissions (kg)				
	1980	1985	1989	1995	2000
Household Batteries	1750.42	2388.64	2467.47	699.82	392.40
Fluorescent/ HID Lamps	99.03	115.40	106.05	133.15	162.94
Paint Residues	108.82	126.69	72.29	9.11	1.99
Thermometers	104.74	131.13	64.75	66.97	66.93
Thermostats	28.53	38.33	44.49	32.10	41.03
Pigments	93.74	101.68	39.72	11.89	5.98
Dental Uses	28.94	25.02	15.89	11.49	9.16
Other	17.12	20.17	5.56	7.53	7.57
Total	2231.33	2947.06	2816.22	972.05	688.00

Source: Appendix 1

Fig. G4: Mercury Discarded - Municipal Solid Waste 1980 - 2000



Source: Table G2

number of discards (lamp sales) are increasing (Table G3, Figure G5). The emissions of mercury begin to increase again at the end of the period since there are technical limitations on reducing the mercury content of lamps any further and the discard rate continues to increase.

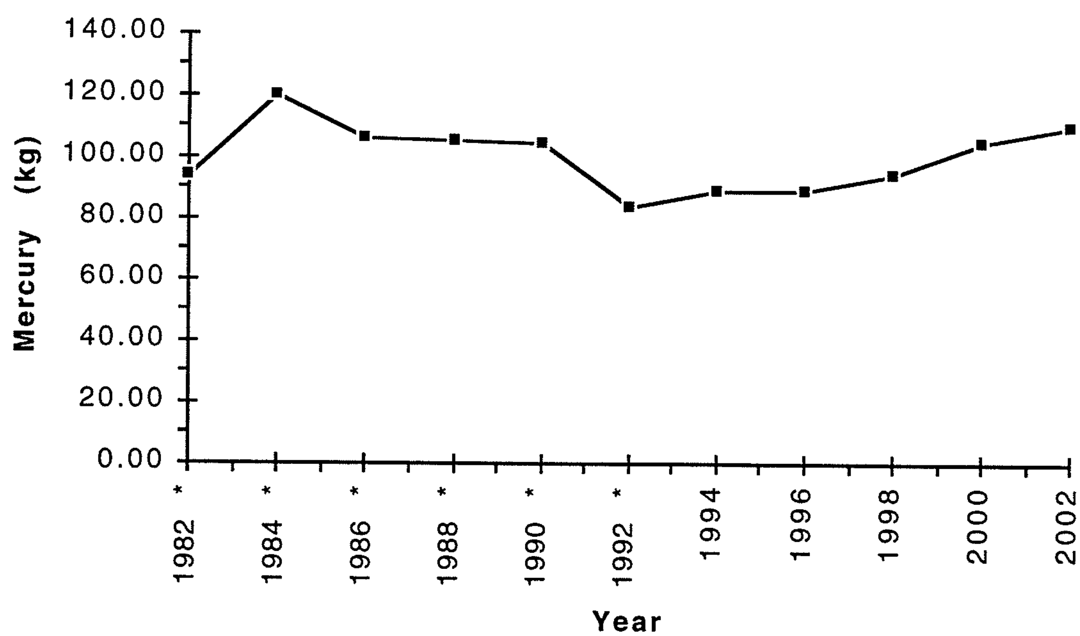
5.3 Program Environmental Changes

During the ten year period of the program the contribution of mercury from lamps is expected to increase from approximately 83 kg in 1992 to 118 kg in 2002 (Table G4, Figure G6). The increase in the release of mercury is less serious then it may otherwise have been due to the decreasing quantities of mercury in lamps. While this source reduction may fail to materialize, it is unlikely since it has been occurring over the last several years and will likely accelerate as lighting waste is identified as hazardous in the United States. Manufacturers will want to avoid reduced sales that may occur if disposal of lamp waste becomes too expensive, or merely troublesome. The reduction in the quantity of mercury used in lamps will plateau given the present knowledge of lighting technology (NEMA October 1992).

Table G3: Mercury emission - No Program (1982-2002)

Year	1982 *	1984 *	1986 *	1988 *	1990 *	1992 *	1994	1996	1998	2000	2002
Fluorescent lamps (kg)	91.92	118.1	104.3	103.6	102.2	80.97	86.00	86.32	90.93	101.4	106.4
H.I.D. lamps (kg)	1.51	1.88	1.55	1.80	1.99	2.28	2.63	2.66	2.78	3.20	3.31
Total Mercury (kg)	93.43	120.0	105.8	105.4	104.1	83.25	88.63	88.98	93.71	104.6	109.8
Fluor. Hg (mg/Lamp)	75.00	75.00	55.00	55.00	55.00	42.00	40.00	36.00	34.00	34.00	32.00
H.I.D. Hg (mg/Lamp)	33.00	33.00	25.00	25.00	25.00	25.00	25.00	22.00	20.00	20.00	18.00
Fl Sales (100 units)	12256	15752	18962	18844	18573	19277	21499	23978	26742	29826	33264
HID sales (10 units)	4569	5689	6182	7202	7943	9136	10510	12089	13906	15996	18401

Fig. G5: Mercury Emissions - No Program 1992-2002



Source: Table G3

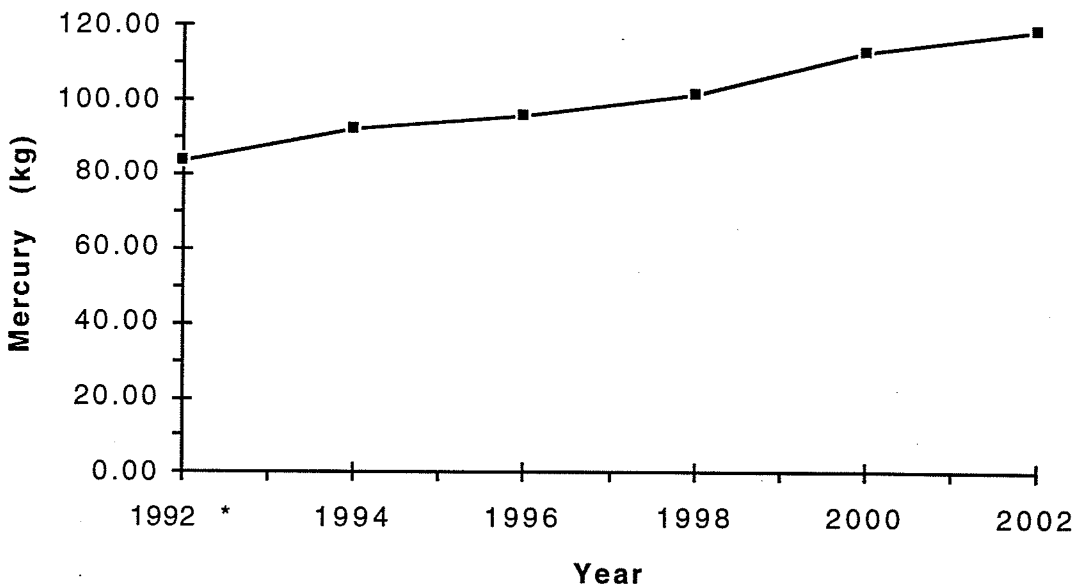
Note: * Emissions based on actual sales data.

Table G4: Mercury emission: Program (1992 - 2002)

	1992 *	1994	1996	1998	2000	2002
Mercury Fluorescent(kg)	80.97	89.47	93.37	98.35	109.68	115.13
Mercury HID (kg)	2.28	2.63	2.66	2.78	3.20	3.31
Mercury Total (kg)	83.25	92.10	96.03	101.13	112.88	118.44
Fluorescent (mg Hg/lamp)	42.00	40.00	36.00	34.00	34.00	32.00
HID (mg Hg/lamp)	25.00	25.00	22.00	20.00	20.00	18.00
Fluorescent Discards/Sales	1927743	2236845	2593513	2892509	3225975	3597885
HID Discards/Sales	91364	105096	120892	139062	159964	184006

Note: All lamps are listed in units.

Fig. G6: Mercury Emissions - Program 1992-2002



Source: Table G4
Note: * Emissions based on actual sales data.

The projected emissions of mercury due to increased use of mercury containing lamps from Franklin and Associates (Table G2, Figure G4) over the next several years shows a 54 % increase in emissions from fluorescent lamps between 1989 and the year 2000. These predictions assumed the increased use of fluorescent lamps but it is not known if the emission rates take into account the expected reductions in the quantity of mercury in lamps. The higher emissions projected by this data may be due to the maturing of the DSM programs in the United States or the underestimation of the program's impact.

6. Significance Assessment

The significance of the predicted environmental changes and impacts of the program will be examined by considering any regulatory limits, the character of the impacts, comparison of impacts with and without the program, environmental component sensitivity, and cumulative changes and impacts.

6.1 Regulatory Limits

6.1.1 Federal Government

Federal government, Crown corporation, and inter-provincial or international transportation or disposal of dangerous goods are the responsibility of the federal government and fall under the Federal *Transportation and Dangerous Goods Act* (TDGA) (Dion May 1993). The defence department is not required to follow either federal or provincial TDGA regulations, whereas Crown corporations are encouraged to also follow provincial TDGA regulations (Dion May

1993). The Federal government allows the province to manage the transport, generation and disposal of Dangerous Goods. Provinces (including Manitoba) have adopted the regulations established under the TDGA.

6.1.2 Manitoba

The province regulates dangerous good generation, storage, transportation and disposal through the *Dangerous Goods Handling and Transportation Act* (R.S.M. 1987, c. D12). Hazardous waste is considered to be a dangerous good under the Act (s.1). Hazardous waste transporters and facilities must be licensed and waste generators must register with the Province according to Kucera (1988). Manitoba regulation 282/87 establishes criteria that determine whether a substance is regulated as a "hazardous waste or a recyclable material" (Kucera 1988:45). The other key regulation related to the classification of hazardous waste is Manitoba Regulation 172/85. He notes that this regulation adopts the federal regulation SOR/85-77 as a regulation under the provincial *Dangerous Goods Handling and Transportation Act*. The federal regulation SOR/85-77 under the *Transportation and Dangerous Goods Act* (Canada) establishes a manifest system that can track hazardous waste from its origin to final disposal ("cradle to grave") (Kucera 1988:45). Kucera notes that the Act contains a list and a set of criteria that classify which products, substances, or organisms are regulated under the Act as dangerous goods.

The application of the criteria within the *Classification Criteria for Products, Substances and Organisms Regulation* (Man. Reg.

282/87) to mercury containing lamps starts with the classification of the waste through several steps. Under the general classification section, lamps would be considered "A not fully specified product..." and classified as Division 3 of Class 9 if the Leachate Extraction Procedure (Schedule B) is failed. According to the regulation, if the Leachate Extraction Procedure determines mercury concentrations to be equal to or in excess of 0.1 mg/l in the waste extract the product is classified as division 3 of class 9 (Schedule B, Table 1). This places the product in packing group 3. It is unlikely that it would be placed in other packing groups which require an indication of chronic toxicity (s.9(6)). Exemptions of products under packing group 3 apply when the component concentration is equal to or less than 100 ppm. and the total quantity per batch is equal to or less than 100 grams (s. 9(8), Table 8). A further exemption exists regarding reportable quantities of hazardous wastes. According to the *Generator Registration And Carrier Licencing Regulation* (Man.Reg. 175/87) the quantity of hazardous wastes of class 9, division 3 cannot exceed 1 l or 1 kg per month.

When data on fluorescent lamps was applied to these criteria it appears that, on average lamps will fail if one assumes that the Manitoba toxic leachate test is similar to the U.S. E.P.A. test (Appendix 3). The test has several differences and while the U.S. test often found fluorescent lamps to be hazardous waste it is difficult to say whether the Manitoba test would do the same.

At present the Manitoba Government does not seem interested in applying the toxic leachate test to fluorescent lighting waste

(Edigier 1993). A lamp waste management strategy would likely follow the lead of other provinces (Edigier 1993).

6.1.3 Other Provinces

Hazardous waste regulations have yet to be applied in Ontario (Jansen 1993), Alberta (Kemp 1993), or British Columbia (B.C. Environment Dept. 1993). The lack of direction in applying the regulations would seem to be due to a lack of interest amongst the public, and because of this a lack of political will in governments. Public pressure would have to grow before any restrictions would be placed on lamp disposal (Kemp 1993).

6.1.4 United States

The U.S. E.P.A. has a toxic leachate regulatory limit of 0.2 mg per liter. The previous E.P.A. toxic leachate test known as the EP Toxicity Test did not find fluorescent lamps to be hazardous waste (NEMA October 1992). However, the U.S. E.P.A. adopted a new test in 1990. The Toxic Characteristic Leachate Procedure (TCLP) was found to produce variable results on fluorescent lamps, where some lamps failed while others did not (NEMA October 1992). The Minnesota Office of Waste Management (MOWM 1993) suggests it is not a problem with the test but with the loss of mercury during the testing procedure when the lamp is crushed and cut into smaller pieces for testing. They note that the regulatory limit is considered by some to be too stringent and that it does not "accurately reflect the behavior (fate and transport) of mercury in landfill or in ground water"

(MOWM 1993:20). The MOWM also contends that significant effects are possible from what appear to be low concentrations of mercury.

> ...average leachate concentration of .002 mg per liter [for mercury] is 2,000 ng per liter, about 300 times higher than Minnesota's surface water standard of 7 ng per liter. Highly contaminated fish are found in lakes with mercury concentrations of only 2 ng per liter (MOWM 1993:20).

The U.S. E.P.A. is considering several regulatory changes that may alter the situation regarding mercury-containing lamp waste, including:

1. Lowering the regulatory level for fluorescent lighting waste.
2. Excluding fluorescent lamp waste from the regulatory provisions. - except in the case where waste is incinerated (Leyland 1992).

6.1.5 <u>Minnesota</u>

Minnesota's hazardous waste regulations are required to be at least as stringent as the federal hazardous waste regulations that accompany the *Resource Conservation and Recovery Act* (RCRA) (MOWM 1993). Minnesota does not allow for the federal hazardous waste very small quantity generator exemption, therefore all non-household generators are regulated as hazardous waste (MOWM 1993). Minnesota's office of waste management (MOWM 1993) notes that if the TCLP test is passed the waste can be disposed of with other waste, however if it fails that waste is now deemed hazardous and is regulated as such. Those businesses, industries and institutions that replace more than 1000 4-foot fluorescent lamps each year must apply for a hazardous waste license that will require notifying the state about what is done with the lamps (MOWM October 1992). Reporting of smaller quantities is not required. No matter what the quantity business, industry, and institutions must manage their waste properly according to the MOWM (October 1992). At present hazardous waste in Minnesota can be managed by one of the following three approaches (MOWM October 1992).

1. Stored on site and packed to prevent breakage; they must also be labeled and records kept indicating that it is a hazardous waste.

2. Stored or recycled off-site in Minnesota; the other requirements in #1 still apply.

3. Stored, recycled, or disposed out of state; the other requirements in #1 still apply, however a licensed hazardous waste transporter is required.

6.1.6 California

The state of California has adopted hazardous waste regulations that regulate fluorescent lighting waste as a hazardous waste when a representative sample fails a waste extraction test (Fong 1993). The regulatory limit for leachate containing mercury is 0.2 mg/l or 25 mg/kg. The state test is considered to be more stringent than the federal E.P.A. TCLP test (outlined earlier), which is also applied in some circumstances. Failure of the state test restricts the waste to manifested transport, and disposal of the wastes to class 1 hazardous facilities or recycling facilities. The state has a 25 tube per day exemption level for these requirements. If the federal TCLP is instead used to test the waste then the 25 tube per day exemption no longer exists.

Lamps that are tested usually fail; regulations in California are expected to be changed by the removal of the 25 tube per day exemption (Fong 1993).

6.2 Occupational Safety Regulations and Health Hazards

No specific regulations are in place in Manitoba according to the Manitoba Environment Department (Dyck 1993). Manitoba has adopted the Workplace Hazardous Materials Information System (WHIMIS). Employers in conjunction with workers establish emissions control guidelines that follow TLV values.

The MOWM (1993:19) noted that the "vapour equilibrium for a freshly crushed lamp is above the threshold limit value of 0.05 mg per cubic meter" as determined by the National Institute for Occupational Health and Safety. The 0.05 mg m^{-3} value is the accepted TLV-TWA (Threshold Limit Value - Time Weighted Average). The TLV-TWA is a time weighted average concentration for mercury vapour in air for a 8 hour work day and 40 hour work week "to which nearly all workers may be repeatedly exposed" on a daily basis without adverse effect (Sigel and Seiler 1988:6). Another occupational health exposure limit is the TLV-C which is the Threshold Limit Value - Ceiling. This is the concentration of a substance that should not be exceeded at any time (Sigel and Seiler 1988:6). The TLV-C for mercury vapour is 0.1 mg Hg m^{-3} in the

United States (Magos 1988). This value is significantly less than the vapor pressure at equilibrium for mercury (13 mg Hg m^{-3}) indicating that under the proper conditions an accident could exceed the TLV-C value.

6.3 Environmental Change & Impact Characterization

6.3.1 Biological Impact Levels

There is little mention of biological impact values for mercury. As noted estimates of the concentration levels of mercury in soil that should be of concern range from 0.4 to 0.5 mg/kg for mineral soils (Swedish Environmental Protection Agency 1991). This concentration level and any other impact values not mentioned are of questionable usefulness unless modelling or measurements are performed to determine the mercury dispersing from the solid waste facilities.

6.3.2 Ambient Human Exposure to Mercury

The natural and anthropogenic release of mercury into the environment makes it impossible for people to avoid absorbing mercury into their bodies. This is not to say that a negative impact will result from this exposure. People have a biological ability to excrete as well as absorb mercury. The primary concern is that the absorption rate not exceed the excretion rate or the concentration of mercury in the body will increase. If it should increase above certain levels health effects outlined earlier may occur.

There are three routes for mercury to enter the body. Magos (1988) describes each of these three routes of entry. Inhalation of mercury vapour averages just less than 200 ng a day for the average U.S. citizen without any occupational or accidental exposure. The analysis of the mercury entering through the lungs indicates that 60% enters as mercury vapour (elemental mercury) while the rest is split between inorganic and organic mercury compounds. This calculation assumes that each of these forms of mercury are retained by the body at a rate of 80%.

He notes that the ingestion of mercury accounts for a considerably larger amount of the total mercury absorbed by the body. The daily average in the United States is 25 μg (25,000 ng). This is broken down into 3.76 μg (3760 ng) methylmercury and 21.24 μg (21,240 ng) inorganic mercury. If it is assumed that 10% of inorganic mercury is absorbed by the gastrointestinal tract and 95% of methylmercury is similarly absorbed then daily oral intake is 2100 ng Hg^{2+} (Mercuricmercury) and 3600 ng CH_3Hg^+ (Methylmercury). The absorption of mercury through the skin has not been well documented according to Magos (1988).

6.4 Impact Duration and Risk - human exposure to mercury from lamps

Opportunities for exposure to the mercury within a lamp occur mainly during installation, removal and disposal of the lamp. If a lamp is broken, mercury is emitted as a vapour from two sources: elemental mercury and mercury that is bound to the phosphor powder (MOWM 1993). The concentration of the mercury in the air is determined by the dispersion rate as well as the volume of air in which the mercury is released. Basically, if the mercury containing lamp is broken in a very small space or a large number of lamps are broken, or both, the concentration can reach levels that can be a health hazard depending upon the room air replacement rate.

A manufacturer of fluorescent lamps noted that no significant exposure to mercury occurs when only one or two lamps are broken (Zalinski 1993). However, the intentional breakage of large numbers of lamps in order to reduce their volume can present a problem. The Minnesota Office of Waste Management suggests that used lamps should not be broken for safety reasons (MOWM 1993). However, group relamping ("systematic replacement of all lamps") is an activity that is suggested by manufacturers to reduce maintenance costs as well as for other reasons (Phillips Lighting n.d.:13).

The promotion of group relamping by manufacturers and utility incentive programs to replace existing lamps with new energy efficient lamps will increase these hazards unless proper guidelines are given to workers.

6.5 <u>With and Without Program Comparison</u>

Since this EA has only two alternatives one of which includes an evaluation without the program there is no need for this section of the EA.

6.6 Sensitivity of Environmental Components

Environmental components that are sensitive to the release of mercury from solid waste sites include groundwater, surface water, and soil. Determining the actual risk to these components would require modeling and testing of different types of solid waste facilities in areas with different conditions (eg., geology, hydrology). Certain solid waste facilities are located in areas where the groundwater is presently being withdrawn for use or is of a high quality and has the potential to be used. When these facilities are situated on sediment that allows leachate to reach the groundwater or surface water a higher risk situation is produced.

The duration, magnitude and probability of this risk is unknown although the Manitoba Environment and Workplace Safety and Health Department (Trask and Hughes 1985:24-29) has done some assessment of the landfill sites in the province. They identified two landfills with a high potential for contaminating groundwater and 49 landfills with a moderate potential for contaminating groundwater. The landfill receiving most of Winnipeg's municipal waste and likely most of the mercury containing lamp waste is the Brady Road site. This landfill is highly unlikely to contaminate groundwater. The other landfill in Winnipeg is the Summit Road site which has a moderate potential for contaminating groundwater .

6.7 Cumulative Environmental Changes & Impacts

6.7.1 Similar Environmental Changes & Impacts from Similar Activities

This EA took an inclusive approach that assessed both Manitoba and Winnipeg Hydro's service areas. It also included HID as well as fluorescent lamps. There are no other similar lighting activities that would result in the emission of mercury.

6.7.2 Similar Environmental Changes From Other Sources

In Manitoba, the total mercury emissions in the solid waste stream are approximated at 2800 kg in 1989. During that year almost 2500 kg was due to batteries while only approximately 106 kg was due to fluorescent/HID lamps. This means that approximately 23 times as much mercury is due to batteries. Batteries are by far the main contributor of mercury to this waste stream. Mining and smelting is the main emitter not part of the municipal solid waste stream. These activities released 3861 kg in 1970 (most recent data) which is over 36 times as much mercury as released by lamps in 1989.

If the predictions of recycling and source reduction for mercury in batteries become a reality then the problem will subside considerably, although batteries will still be the major contributor of mercury in the solid waste stream (Table G2, Figure G4). The mining and smelting industry is expected to continue to be the major emitter unless emissions control equipment is installed.

7.0 Evaluation of Alternatives

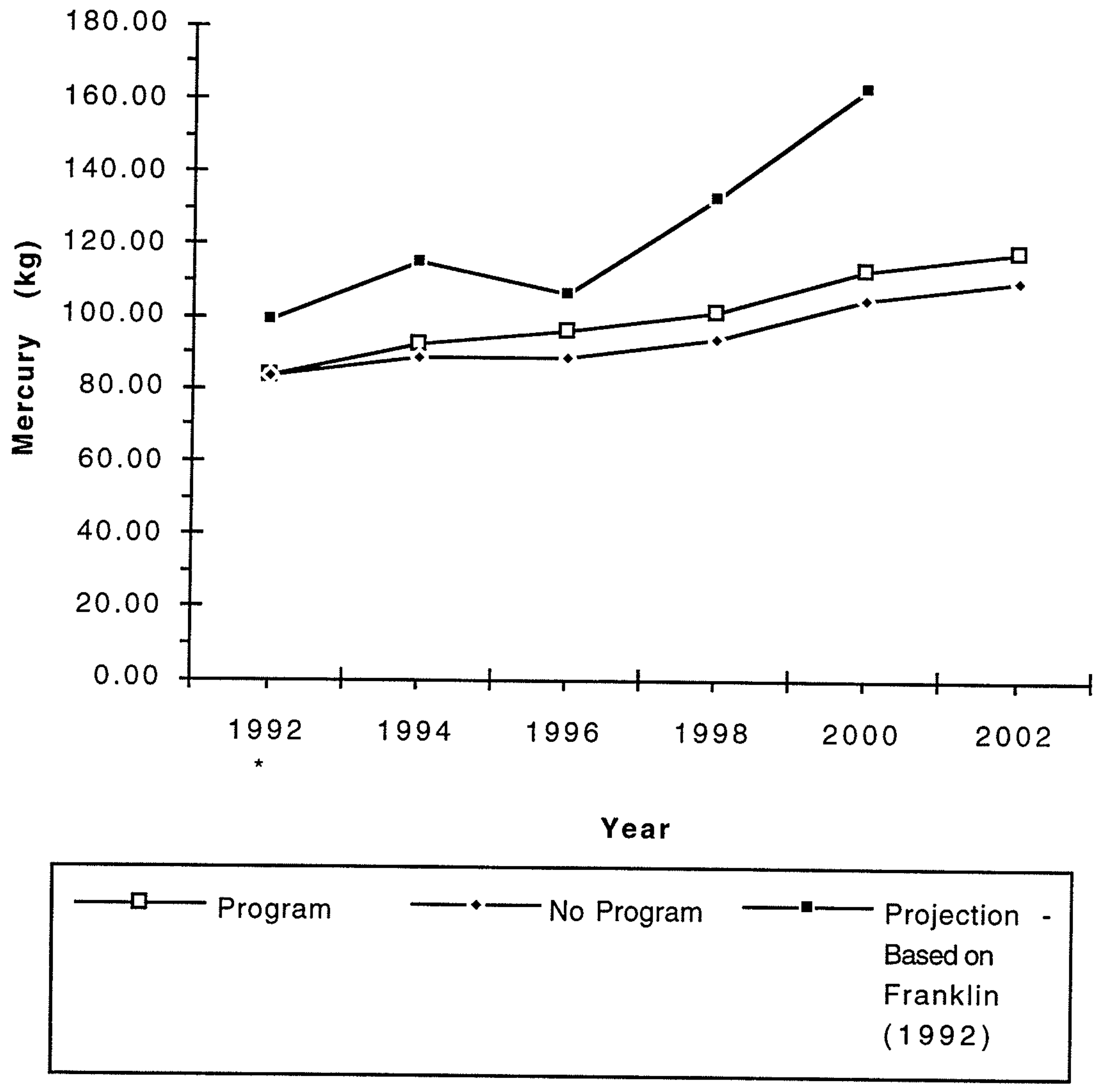
The comparison of mercury emissions due to the program indicate that without the program emissions would remain relatively stable. If the DSM program had not been in place then the emissions of mercury would have increased from approximately 80 to 100 kg/year from 1992 to 2002 (Figure G7). However, the program increases emissions by approximately 7% above the no program level to almost 120 kg/year between the years 1992 and 2002. The Manitoba estimates (Table G2) based on the U.S. projections from Franklin (1992) suggests a far larger (45%) increase in emissions from fluorescent lamps in a similar time period (1989 - 2000). A comparison of the program alternative with the Franklin projection indicates the main difference is a higher initial emission level in 1992 and a higher rate of change in emissions from 1996 onwards.

The difference in mercury emissions between the two alternatives is almost 9 kg/yr in the year 2000. This represents an increase of 1.7% in the total mercury discarded into the municipal solid waste stream in that year.

8.0 Mitigation methods

There are several mitigation methods that can be used to reduce mercury emissions. Each of these will be described and examples given of their application.

Fig. G7 : Mercury Emissions - Program/No Program/Franklin (1992 - 2002)



Note: * Emissions based on actual sales data.

Source: Table G2, Table G3, Table G4

8.1 Landfill

Although the viability of continuing to place fluorescent lamps in landfills is being questioned it still remains an alternative. The U.S. Environmental Protection Agency (E.P.A.) has done some testing of landfills and has found relatively low levels of mercury indicating there is little impact from lamp wastes (Leyland 1992). Several landfill options exist (NEMA October 1992:7):

1. Dispose in a quality solid waste landfill (one having liners and leachate collection systems).
2. Dispose in any solid waste landfill.
3. Dispose in a hazardous waste landfill without any pretreatment.
4. Landfill in small monofill cells or construction/debris landfills.
5. Treat according to federal (RCRA) treatment standards before landfilling in either a solid waste landfill or hazardous waste landfill.

One of the forms of treating waste is to stabilize the mercury in the waste as an insoluble salt such as mercury sulphide before disposing in a hazardous waste landfill (MOWM 1993).

8.2 Incineration

There are two waste management options that involve incineration (NEMA Oct.1992:7):

1. Incinerate in a hazardous waste incinerator and manage the ash in a hazardous waste landfill.

2. Incinerate in a municipal solid waste incinerator with mercury controls, and manage ash in a solid or hazardous waste landfill depending upon the ash characterization.

Incineration in a solid waste incinerator is not a recommended alternative (NEMA October 1992).

8.3 Recycling or Reclamation

Various methods have been developed to recycle mercury containing lamps, in most cases fluorescent lamps. In all cases the methods involve breaking the lamps, separating the phosphor and mercury from the glass and metal and plastic parts.

The more sophisticated methods separate the mercury from the phosphor through heating and distillation. This collected mercury can then be further refined later for re-use in some applications.

Other less complex methods do not recycle the mercury, but do recycle other components. The simplest of methods involve crushing the lamps under a water spray to retain the phosphor powder and collecting the crushed glass, metal parts, phosphor powder, mercury, and spray water in a large bag containing an absorbent material. The bag is later disposed of as hazardous waste.

The costs of recycling have been estimated by NEMA as requiring an initial investment in recycling centers of $115 million U.S. dollars to handle the annual number of lamps requiring disposal in the United States. The total costs of lamp reclamation is estimated to be from $ .51 to $.56 (U.S.) per lamp net of any profit from reclaimed materials (NEMA October 1992). Using these estimates in the Manitoba context while assuming similar per-capita initial investment in recycling centers we can estimate the expected costs of reclamation in the province.[4] The cost would be $.59 to $.64 per lamp. If Manitoba disposes of approximately 2 lamps per person then the annual cost would be $1.28 to $1.4 million dollars. The initial investment would be approximately $577,456 for recycling centers.

8.4 Source Reduction

The amount of mercury in lamps has been slowly declining over the last decade. NEMA estimates that the average amount of mercury placed in 4 foot fluorescent lamps has gone from 48.2 mg in 1985, to 41.6 mg in 1990 (NEMA October 1992). They project that by 1995 the amount will reach 27.0 mg. This is very near the limit at which the lamps can no longer operate and likely represents the lower limit for source reduction at present (NEMA October 1992). Other substitute substances are less environmentally desirable (e.g., Cadmium) (NEMA October 1992).

8.5 Mitigation Examples

8.5.1 California

California has three companies that are presently recycling waste from fluorescent lamps within the state. Approximately 15% of the 50 million fluorescent lamps disposed of in the state are recycled by these three companies at present (Fong 1993).

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4 This calculation assumes an exchange rate of $1.15 Canadian Dollars per U.S. Dollar. The U.S. population is assumed to be 250 million people (1990 estimate) and the population of Manitoba 1.0916 million people (1990).

Facilities have been processing waste for several years in California according to the Minnesota Office of Waste Management (MOWM 1993). Mercury Technologies has operated a facility that separates glass, metal end caps, and phosphor. The phosphor is collected and the mercury recovered. Lighting Resources uses another process that also separates the components of the lamps. Mercury Recovery is another company that separates the individual components of lamps and collects mercury vapour.

Mercury and phosphor from recycling companies are further processed by two companies Mercury Refining in Latham, New York and Bethlehem Apparatus in Hellertown, Pennsylvania (MOWM 1993).

8.5.2 Minnesota

Minnesota has two companies that are in the midst of developing recycling systems according to the MOWM (1993). One company, Mercury Technologies of Minnesota uses a dry-crushing system that recovers mercury from lamp phosphor, glass is recovered for marketing and the end-caps and mounting assemblies are also separated and marketed.

Resource Recovery, Inc., is another company developing a recycling system in the state.

8.5.3 Sweden

Short-term: System for disposal and labeling.

Long-term: phase-out of mercury in lamps (SEPA 1991:28).

8.5.4 Other Places

Facilities are being developed for recycling in Tennessee, Massachusetts, Utah, Arizona, Hawaii, Ontario

9. Conclusions

1. The reduction in the amount of mercury used in lamps (ie. source reduction) will reduce the emissions of mercury to the environment from the increased use of mercury containing lamps. However, there will still be a net increase in emissions of mercury from the program to the environment.

2. Mercury containing lamps are not a major emitter of mercury to the environment when compared with other sources. Metal processing and mercury containing batteries together contribute 90% of the mercury released into the environment in Manitoba by people.

3. There is no conclusive data to determine the risk to workers and homeowners who handle mercury containing lamps during installation, removal and disposal.

4. The trend in the United States and Europe towards recycling mercury containing lamps could spread to Canada. Recently, in Ontario there has been limited activity in recovering mercury from lamps. Existing legislation is sufficient to determine these wastes as hazardous. However, at present the Manitoba government and other provinces are not enforcing these regulations to as full an extent as

possible. This could change in time. The first area of application is likely to be on large-scale relamping programs where significant quantities of these lamps are being disposed of at one time. It is here that the greatest potential health risk occurs, and it is also where waste is most likely to be tested.

5. There are no obvious solutions to the management of lamp waste. While the large scale relamping programs can be effectively merged with a recycling facility this is not easy with very small quantity generators such as households. The awkward physical nature of these lamps suggests they should be handled as little as possible by unskilled people in order to limit breakage and possible accidental exposure to mercury. This suggests that unless a household hazardous waste pickup program is independently developed these wastes will continue to be disposed of in regular waste collection. This raises two concerns.

It is possible that the crushing of these lamps by waste collection trucks is leading to health effects for workers who crush large numbers of lamps. This would be most likely for those trucks that compact waste while a worker stands beside the truck as opposed to those trucks where the worker remains inside.

Another concern is that the solid waste landfill that receives these wastes may eventually be contaminated by the mercury and as the mercury leaches into the surrounding groundwater or evaporates into the air, the contamination will spread. The seriousness of this problem is currently being considered by the U.S. E.P.A., however early indications are that leaching is limited. Landfills may continue to be an acceptable place for the disposal of this waste. Although this waste management solution may be constrained by the characteristics of the landfill site, since some sites are susceptible to the contamination of nearby groundwater.

9.1 Recommendations

1. It is recommended that Manitoba Hydro work with industry and the Province of Manitoba in developing a set of guidelines for the collection, disposal and or recycling of some mercury containing lamp waste. Primary concern should be the large scale relampings that may occur within institutions and businesses. An upcoming report from the EPA and NEMA should provide more definite determinations of the risk associated with mercury containing lamps and the best waste management methods.

2. The health risks to maintenance workers, waste collection workers and homeowners from mercury need further study to determine whether a significant risk exists. Specifically, large-scale relamping efforts need to be examined and guidelines developed for lamp removal, installation, disposal and the handling that occurs with each of these procedures.

3. In a larger context the Canadian Government through Environment Canada should be encouraged to consider labeling mercury containing lamps for the mercury hazard in order to make people aware of the potential health risks from breakage.

4. Several landfill sites in the province are at a higher risk of contaminating nearby groundwater. Consideration should be given to determine whether it is appropriate to place lamp waste, especially large quantities, in these landfill sites.

Appendix 1: Method for calculating the mercury discarded in the Manitoba municipal solid waste stream 1980 - 2000

The calculation of mercury in the Manitoba municipal solid waste stream between the years 1980 and 2000 used United States data and the following procedure.

1. Data describing the amount of mercury discarded in municipal solid waste (Franklin 1992) was converted to per-capita form for each product and for each year using census and projected demographic data for the United States (U.S. Bureau of Census 1991).

2. The per-capita values of mercury discarded in municipal solid waste in the United States are then multiplied by the census and projection derived populations of Manitoba for the same years.[5]

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5 See Appendix 2

Appendix 2: Method for calculating the population of Canada and Manitoba for 1993 - 2002

The population of Manitoba and Canada are projected from 1992 using the following procedure.

1. The mean annual rate of population change was calculated by taking the mean of the annual rates of population change between 1982 and 1990 (Statistics Canada 1990, Statistics Canada 1992). The mean annual rates of population change were determined to be an increase of 0.736% per year for Manitoba and 1.044% per year for Canada.

2. The population of Manitoba and Canada for 1992 were determined from Statistics Canada data (Statistics Canada 1990, Statistics Canada 1992).

3. The mean annual rates of population change of Manitoba and Canada were applied to the populations of Manitoba and Canada, respectively to produce the projection population values for the following year (eg., A mean annual population change of 2% increase per year applied to 1000 people is the product of 1.02 and 1000 or 1020 people.).

4. Step 3 was repeated for each year until the end of the projection period.

Appendix 3: Waste Classification

Assumptions: (Science Applications International Corporation. 1992)

1. Average fluorescent lamp has a mercury content of 33 mg or .033 g.
2. Average fluorescent lamp has a mass of 280 g.

Requirements for exemption: Division 3 of class 9 for packing group 3

1. Component (Mercury) concentration equal to or less than 100 ppm

and

2. Total quantity component (Mercury) per batch is equal or less than 100 g.

Calculations:

1. Component concentration = $\frac{\text{Avg. Mercury Content of a Lamp}}{\text{Avg. Mass of Lamp}}$

$= \frac{.033 \text{ g}}{280 \text{ g}}$

$= 1.17 \times 10^{-4}$ g Hg g^{-1}

= 117 ppm Hg

= Exemption requirement is not met.

2. Total quantity of component = Easily passes since 100 g Hg would be found in 3030 Four Foot Lamps. This is an unusually large quantity of lamps to be discarded at one time.

= Exemption requirement is met.

Result: **No exemption because the component concentration is > 100 ppm.**