Environmental Assessment of Demand-Side Management Programs

J. TURNER and J. SINCLAIR

Demand side management (DSM) programs provide unique challenges to environmental impact assessment (EA). It is unclear whether traditional EA is warranted, or, what framework such an EA should have. This paper discusses the characteristics of the environmental impacts of DSM programs and decides that an EA is required when programs introduce new technologies or practices, or when positive impacts need to be more clearly defined. The results of a survey of international utilities identified four types of DSM EAs. From this, and the literature, a number of EA approaches are developed and evaluated. A multi-staged DSM EA framework is developed and applied to a DSM program.

Les programmes de gestion axée sur la demande(GAD) offrent des défis uniques à l'évaluation des impacts sur l'environnement (EIE). On ne sait pas encore très bien si une EIE traditionnelle se justifie ni le cadre dans lequel une telle EIE devrait s'effectuer. Cet article discute des caractéristiques des impacts environnementaux des programmes de GAD et conclut qu'une EIE est nécessaire lorsque les programmes présentent des nouvelles technologies ou pratiques ou lorsqu'il faut clarifier davantage les impacts positifs. Les résultats d'une enquête menée sur les entreprises de services publics ont identifié quatre types d'EIE de la GAD. À partir de cette dernière et d'un certain nombre de documents, diverses approches de l'EIE sont développées et évaluées. Un cadre d'EIE de la GAD constitué de plusieurs étapes est développé et appliqué à un programme de GAD.

Jeff Turner and John Sinclair are with the Natural Resources Institute, University of Manitoba.

Introduction

Many electrical utilities have initiated programs to control the growth of demand. As reported by many others (McInnes and Unterwurzacher, 1991; Mills, 1991; Gellings Faruqui, and Seiden, 1991; among others) these demand-side management (DSM) programs have included a variety of measures to promote energy efficiency. While the environmental impacts of DSM are presumed to be much smaller than those of existing energy supply options, their actual effects have received little attention. Potential impacts on indoor and outdoor air quality, deterioration of the ozone layer, and ground water quality, among other impacts, may occur (MOWM, 1993; Pace, 1991; McInnes and Unterwurzacher, 1991; EPRI and Edison Electric Institute, 1984). As utilities adopt DSM programs, tools are required for evaluating these potential impacts.

Environmental impact assessment (EA) is widely applied to large energy developments, but it is not clear whether DSM programs deserve similar treatment. It is also unclear whether utilities are presently performing EAs for DSM programs, and what process of assessment they are using. Each of these areas is investigated with the intent of determining the optimal framework for a DSM EA.

Framework Design

The development of a framework for DSM EA entailed a general review of environmental assessment literature (Holling, 1978; Bisset, 1980; Rosenberg, 1981; Beanlands and Duinker, 1983; Munro, Bryant and Matte-Baker, 1986; Lawrence, 1994; among others), and more specifically, policy and program assessment (Grove-White, 1984; Gibson and Savan, 1986; World Bank, 1991; Bregha et al., 1990), as well as the impacts and mitigation of impacts of DSM programs (EPRI and Edison Electric Institute, 1984; McInnes and Unterwuzacher, 1991; Pace, 1991; Manitoba Hydro, 1991).

Since little published information is available relating to program level EA, this gap in the literature was filled by the use of mail inquiries and interviews. The legal requirements for DSM program EAs were determined from literature, government documents, legislation, and interviews.

A questionnaire of selected utilities was used to determine the present and anticipated procedures for the EA of DSM programs and the management of the impacts of DSM programs at power utilities.[1] The survey was provided to personnel at most Canadian utilities (11), many of the larger United States utilities (9), as well as European utilities (8). The purpose of the survey was to determine what EA process, if any, utilities apply or planned to apply to their DSM programs. Two series of questions were provided: one for those who have performed some form of EA on their DSM programs; and one for those who had not.

A number of alternative EA frameworks were developed and evaluated according to several criteria. The preferred framework was developed in further detail and it was tested by application to a utility DSM program.

1/ Copies of the survey questionnaires are available from the authors upon request.

Demand-Side Management

DSM programs use a variety of different means to manage electricity demand. Gellings and Talukdar (1987) provide a series of useful descriptions of different DSM measures. Strategic conservation is the best known DSM measure; this involves reducing the demand for electricity without any shift in demand to another time. Peak clipping is a DSM activity used to reduce electricity demand during peak use periods of the day, thereby lowering the peak demand that utilities must meet. Valley filling is used by the utility to increase electrical load in off-peak periods. Load shifting is the movement of loads from peak periods without any shift in energy use patterns. Strategic load growth is used to increase market share where competition with other energy sources occurs. Utilities use flexible load shaping to change the electrical load at any time by providing electricity at reduced levels of reliability.

DSM measures produce both positive and negative impacts that vary with the particular measure and with the sources of supply that are displaced by these measures.

Environmental Impacts of DSM Programs

The environmental impacts of DSM programs occur along two different pathways. On the first pathway, program measures create environmental changes and impacts through the release of environmental contaminants or altered exposure to existing contaminants. For example, a DSM program that encourages the use of energy-efficient lighting systems could lead to the increased release of some contaminants into the environment (Table 1). Depending upon the lighting equipment, environmental contaminants could include mercury, polychlorinated biphenyls (PCBs) or radioisotopes (Pace, 1991; Competitek, 1988, as quoted in Pace, 1991). In the absence of appropriate mitigation measures, some of the potential areas of impact include human health, and ground water quality (MOWM, 1993; Competitek, 1988, as quoted in Pace, 1991).

Table 1: Potential Environmental Changes and Impacts of DSM Programs

DSM Program Measures	Type of Measure	Potential Environmental Changes (Contaminants)	Potential Impacts
Home Weatherization • Insulation • Weatherstripping	Strategic Conservation	• Solid Waste • Indoor Air Pollutants • Avoided [1]	• Health • Landfill Space • Avoided
Energy Efficient Lighting • Mercury containing lamps	Strategic Conservation	• Solid Waste • Mercury/PCBs • Avoided	• Landfill Space • Global Warming • Health • Ground Water • Avoided
Energy Efficient Refrigeration and HVAC	Strategic Conservation	• Solid Waste • CFCs • Indoor Air Pollutants • Avoided	• Health • Landfill Space • Global Warming • Ozone Depletion • Avoided
Ground Water Heat Pumps	Strategic Conservation	• Solid Waste • Avoided	• Landfill Space • Global Warming • Ozone Depletion • Avoided
Energy Efficient Motors	Strategic Conservation	• Solid Waste • Avoided	• Landfill Space • Global Warming • Ozone Depletion • Avoided
Curtailable Electricity Rates	Flexible Load Shaping	• Avoided	• Avoided

1/ 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.

Alternatively, exposure to existing environmental contaminants may be changed. This is best visualized in the reduced air exchange that occurs with newer energy-efficient home designs. Here existing environmental contaminants (e.g., tobacco smoke) reach higher concentrations unless mitigation measures, such as the installation of air-to-air heat exchangers, are implemented.

An important distinguishing feature of the environmental impacts of many DSM measures is the considerable length of time between a DSM program measure and any induced impact. The presence of a large base of installed equipment and changes in consumer purchasing habits can lead to impacts occurring well beyond the lifetime of the program. In addition, the type of equipment may also have a significant effect on the dispersal of environmental impacts. In the case of home appliances, many, if not all of the impacts may occur at or on the way to a landfill. In other cases contaminants will disperse from diverse locations and impact a specific bio-physical system, for example CFCs leaking from heating/cooling equipment that eventually degrade the ozone layer.

A second pathway for environmental impacts follows from program-induced demand changes that alter the need to generate electricity. These are avoided supply-side impacts: without the program the electricity would need to be produced, along with all the related environmental impacts. These are usually positive impacts. When considering these impacts it is 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 (Platis and McCammond, n.d.). Electricity demand at the margin thus has a temporal aspect.

In some utilities, electricity required to meet the daily or seasonal margin has been supplied by fossil fuel power plants, that save fuel and reduce related emissions (e.g., sulphur dioxide, carbon dioxide, particulates) when generation from these sources is not needed (Platis and McCammond, n.d.). Avoided impacts are highly dependent upon the source of energy; if hydro-electric generation provides the energy supply, only water use is reduced and this is dependent upon the availability of reservoir water storage.

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 can meet demand; however, the daily and seasonal peaks will also increase. In these cases the only options are either to conserve, import electricity, or add new generation facilities. Therefore reducing 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 facilities. If DSM programs reduce demand then the requirement for new generation, and the associated impacts, can be delayed. 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 in relation to the magnitude of some impacts.

While both positive and negative impacts can result from DSM programs, the negative impacts are typically individually small and usually outweighed by the reduction of larger impacts resulting from using less fuel and being able to avoid or defer development of new generation capacity (Pace, 1991; Ontario Hydro, 1992; Mills, 1991). It is even thought that many of the negative impacts due to the release of contaminants can be mitigated if significant, assuming they are identified at the outset of a program (Pace, 1991). Performing an EA may be necessary to ensure public health or safety in this regard, and to identify, to a utility, necessary action. Mitigation may also be necessary and considered as part of the EA.

An important aspect of DSM programs is that they often rely on market mechanisms to promote energy conservation. The presence of any real or perceived hazards may reduce the effectiveness of these programs. If the expected positive environmental impacts of a program are to be realized, then the impediments to participation should be reduced wherever possible. By extension, this may include mitigation of all potential impacts including the "insignificant" ones. In some cases positive impacts may be enhanced for similar reasons. Clearly, there are two sides to the examination of these impacts: while insignificant impacts may be publicized without good reason, other impacts may be detected before programs are implemented and the environment impacted or a program impaired. The certain costs of assessment are substituted for the uncertain costs of undetermined environmental impacts. Environmental assessment is the means by which impacts can be identified, evaluated, and mitigated if necessary.

EA Process – Applications in Different Jurisdictions

The survey revealed that utilities in Canada, the United States, and Europe have thus far performed less formal, in-house, environmental analysis of the potential environmental impacts from DSM programs. Within Canada the application of formal EA to DSM programs and utility power resource plans is still in its infancy. Despite the increased frequency of policy and program assessment, only Ontario requires that DSM programs receive any form of EA. In this case DSM programs are indirectly assessed when Ontario Hydro's 25-year demand/supply plan is reviewed. In the US, federal power authorities (e.g., Bonneville Power Administration) are required to produce environmental impact statements when major actions may significantly impact the quality of the human environment (Douglas, 1991). The Bonneville Power Administration has produced EAs of both individual DSM programs and long-term demand/supply plans (BPA, 1988; BPA, 1992). Outside of the resource planning process, the DSM EA may also be a useful tool for identifying, evaluating, and mitigating the impacts of DSM programs within a utility's environmental management system.

The survey of the utilities identified four main types of EA in use:

1. EAs are used as a planning tool to 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 are used to find the "true" cost and cost-effectiveness of DSM programs to the utility and society.
3. An issue-oriented EA is used when a DSM 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. Some issue-oriented EAs consider an issue related to all resources, both supply and demand. Examples have been given of assessments of trends in environmental regulations.

In addition, 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.

The four main types differ in terms of the issues they examine as well as the level of detail in which this is done. Although none are traditional forms of EA in comparison to the literature, they accomplish one of its main objectives: determining environmental impacts and including them in the decision-making process.

Beyond the four individual assessment types identified, a number of EA characteristics were indicated by utilities that performed EAs. Generally, DSM assessments occurred at the later stages of the planning process, most frequently during the development of the overall DSM program plan and individual DSM programs. Placing assessments later in the planning process has the obvious advantage of increasingly reliable information for making impact predictions. These assessments may also prove less costly since fewer alternatives need to be considered. In other respects, however, the usefulness of these assessments can be significantly reduced by prior decisions that had foregone planning alternatives. If the objective of assessment is to influence the decision making process then a tradeoff may be required between the effectiveness of the assessment and the certainty of the impact predictions. In the end, the increased uncertainty of impact predictions that occurs at the initiation of EAs with less than complete information is accepted in return for earlier and more effective assessment.

Where assessments were performed, they seldom occurred at more than one stage in the broader utility planning process. In addition, public involvement in DSM EAs was limited, except where mandated by a public hearing process that reviewed power resource plans or EAs. Public involvement at an earlier stage is not common. Life cycle analysis of DSM products was performed by several utilities, however none suggested that the manufacturers of these products be required to do so. Responsibility for mitigation was identified as primarily resting with the utilities in terms of implementation, funding, and monitoring. Not surprisingly, most utilities indicated that limited staff and monetary resources restricted the EA that was performed on DSM programs. It appears that in allocating scarce resources some utilities placed a lower value on the benefits of DSM EA than on other activities. Despite these concerns, many utilities felt the EA of DSM was necessary. A streamlined process would reduce costs and therefore encourage the assessment of DSM programs.

A DSM EA Framework

Although the survey revealed that utilities are performing new variants of EA on their DSM programs, it was evident that some of the common elements of traditional EAs remain crucial to understanding impacts. Scoping is one of these elements. Issues, including the need for the program, alternative means of meeting this need, boundaries of the assessment, and identification of the possible impacts on components of the environment are all discussed as part of scoping. Respondents indicated that checklists were the most common method for identifying impacts, followed by matrices and network analysis.

Impact prediction follows the scoping process. This includes the prediction of baseline conditions from which impact predictions can be made. A number of approaches are available for predicting impacts according to the literature and respondents. The use of expert judgements or extrapolation from "verified predictions," the use of applicable existing models of relationships, and the formation of a testable impact hypothesis are examples (Whitney and Maclaren, 1985). The use of expert judgement, computer modelling, and ad hoc committee approaches were suggested by respondents.

Predicting and evaluating these impacts may prove difficult due to the large number of DSM program participants and the variability of the environment and of each situation. More likely is the use of changes to the environment as a proxy for estimating environmental impacts as used in other program EAs, for example the EA of the Netherlands' draft ten-year program on waste management, and the Ontario Hydro supply-side environmental effects study (AOO, 1992; Ontario Hydro, 1992). In some cases it may also be possible to identify specific health impacts or sensitive environmental components.

Determining whether impact predictions should be considered in decision making is the objective of the significance assessment; this process may use a number of different criteria (e.g., statistical, ecological, social – as suggested by Beanlands and Duinker (1983)). Respondents indicated regulatory levels and baseline conditions as the most likely means of setting these criteria. Following the significance assessment is an evaluation of the importance of significant impacts of program alternatives (Lawrence, 1994). Few respondents indicated this as a part of their EAs.

The evaluation of mitigation alternatives and suggestions for the monitoring of impacts is a final part of many EAs. Mitigation requirements were identified most often during the scoping stage, less often during the significance assessment stage, and after the EAs by respondents. Mitigation was a result of both independent analysis and environmental regulations. It was unclear whether monitoring was considered in these EAs.

A large number of different EA approaches are available to provide proper assessment of DSM programs. The scope of these approaches varies greatly, from the assessment of a complete utility power resource plan at an early stage of the utility planning process to the assessment of one aspect of a DSM program at a later stage of the planning process. To be useful, assessments must provide information before supply or demand resource alternatives have been limited by a decision; therefore the timing of these approaches is largely dictated by their scope.

Each potential EA approach is related to different stages in a typical utility planning process (Table 2). The power resource planning stage is where demand and supply resources are evaluated. During this stage of planning a variety of approaches, sequentially numbered in Table 2, can be used to perform an EA. The DSM program planning stage occurs at the latter part of the power resource planning process. At this stage previous decisions limit useful impact assessment to considering one, or many, DSM programs, and in some cases only specific issues related to these programs. As noted in the literature, interviews, and survey responses, impacts can be evaluated using environmental costing and a variety of qualitative or quantitative approaches with varying levels of scope.

The process of selecting an optimal DSM EA framework began by defining three criteria

Table 2: Evaluation of EA Approaches

Stage of Planning Process	EA Approaches	Evaluation Criteria: Information Available	Need	Limited resources	Feasibility
Early stage of power resource planning	(1) Integration of environmental costing	Yes, for non site-specific resources	Yes	Yes	Conditional - in some cases
	(2) EA of power resource options	Yes	Yes	No	No
Late stage of power resource planning	(3) Quantified EA of all power resource sequences	No			No
	(4) Quantified EA of some power resource sequences	Yes, for non site-specific resources	Yes	Yes	Conditional - in some cases.
	(5) EA of selective issues	Yes	Yes	Yes	Yes
Early stage of DSM program planning	(6) Complete EA of all DSM programs	Yes	No		No
	(5) EA of selective issues	Yes	Yes	Yes	Yes
Late stage of DSM program planning	(7) Full EA of individual DSM programs	Yes	No		No
	(5) EA of selective issues	Yes	Yes	Yes	Yes

to use in the evaluation. These criteria are ordered in terms of their application to each approach. Each is related to the practicalities of performing any study. When criteria are not met, then that particular approach receives no further consideration.

First, is there sufficient information to use this EA approach? Without sufficient information the EA would fail to produce meaningful results that can be used in the planning process. In most cases, sufficient information exists when an EA approach can either use generic information, or follows an earlier EA, likely an EA with a wider scope. Several organizations have used one or both approaches (e.g., Bonneville Power Administration; Ontario Hydro; the Netherlands Ministry of Housing, Physical Planning and the Environment). However, generic impact estimates do have limitations, one of these is their use with highly site-specific impacts, such as hydroelectric facilities (Pace, 1991).

Second, is there adequate need for this new EA approach? Survey respondents and the literature suggest a major impediment to DSM EA is the scarcity of resources. However, allocation of resources requires some level of prioritization. Two conditions were used to determine need. 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.

Third, does the EA approach require a significant commitment of resources? Although the first two criteria may be met, there may be no point in attempting forms of analysis that require resources beyond those available to most utilities. The introduction of a new EA approach, its frequency of use and scope of application all come into play when deciding the level of resources required by an approach.

The evaluation of EA approaches for DSM

programs eliminated most based on criteria considered critical for performing an assessment. The remaining options included the *Integration of Environmental Costing*, the *EA of Power Resource Options*, the *Quantified EA of All Power Resource Sequences*, and the *EA of Selective Issues*. The *Integration of Environmental Costing* approach, presently requires a separate evaluation of site-specific and non site-specific impacts of power resources. This limits the use of this approach until the costing of these different resources reaches the same level of maturity, and comparisons become more relevant. The *EA of Power Resource Options* approach has significant resource requirements. Although it merits further study it is not considered feasible at this time. The *Quantified EA of Power Resource Sequences* approach, may be feasible for evaluating the non site-specific impacts of some resources, but defining site-specific impacts requires prior completion of a more comprehensive EA. The remaining approach is the *EA of Selective Issues*. For a number of reasons it is distinguished from the others, and is the most feasible: it can be applied at different places in the planning process; and it is most appropriate with respect to the advanced nature of DSM planning within the overall planning process; etc.

The optimal DSM EA framework was therefore developed around the *EA of Selective Issues*. This EA is applied where the need is identified in the planning process. It has two stages, each with different objectives (Figure 1). The first stage identifies direct impacts noted as potentially significant by a previous EA, or another part of the planning process. A survey is used to discern what (if any) public concerns exist about the environmental changes or impacts of the program. Only the no program alternative is considered, since there are no other alternatives at this point. An optional part is the application of alternative scenarios for making program impact predictions. This stage of the EA determines whether mitigation is necessary.

The second stage of the EA is optional and is performed only if mitigation measures are considered necessary by the first stage. Here, the objective is the evaluation of mitigation alternatives. These include the program and no program alternatives evaluated in the first stage as well as other alternatives. Further public involvement occurs through consultation with interest groups and public meetings that help build consensus as well as involvement in mitigation efforts. The second stage builds upon the first stage. Scoping, impact identification, parts of the significance assessment, and the impact prediction-baseline are not repeated.

The scope of the impacts considered by the EA varies between the DSM program being considered and the identified impacts. Usually, specific program impacts or effects are identified by an earlier EA or the planning process. These impacts are estimated by determining changes to environmental components. The significance of environmental changes can be measured by their comparison against the baseline conditions as well as regulations and standards.

Avoided supply-side impacts are not assessed in this EA for several reasons. These are better assessed at earlier stages in the planning process when tradeoffs can be made between DSM programs and supply resources. In addition, these impacts are generally positive and therefore not important to the evaluation of mitigation alternatives. Should a program be changed or replaced to mitigate impacts, the avoided supply-side impacts would remain unchanged if we assume demand is equally reduced by the altered or new DSM program.[2] The assessment of a load-shifting program would be an exception since these programs do not result in a demand reduction with related positive impacts. In this instance, avoided supply-side impacts would be considered along with other impacts, likely during an earlier EA that considered all DSM programs or supply resources.

2/ 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.

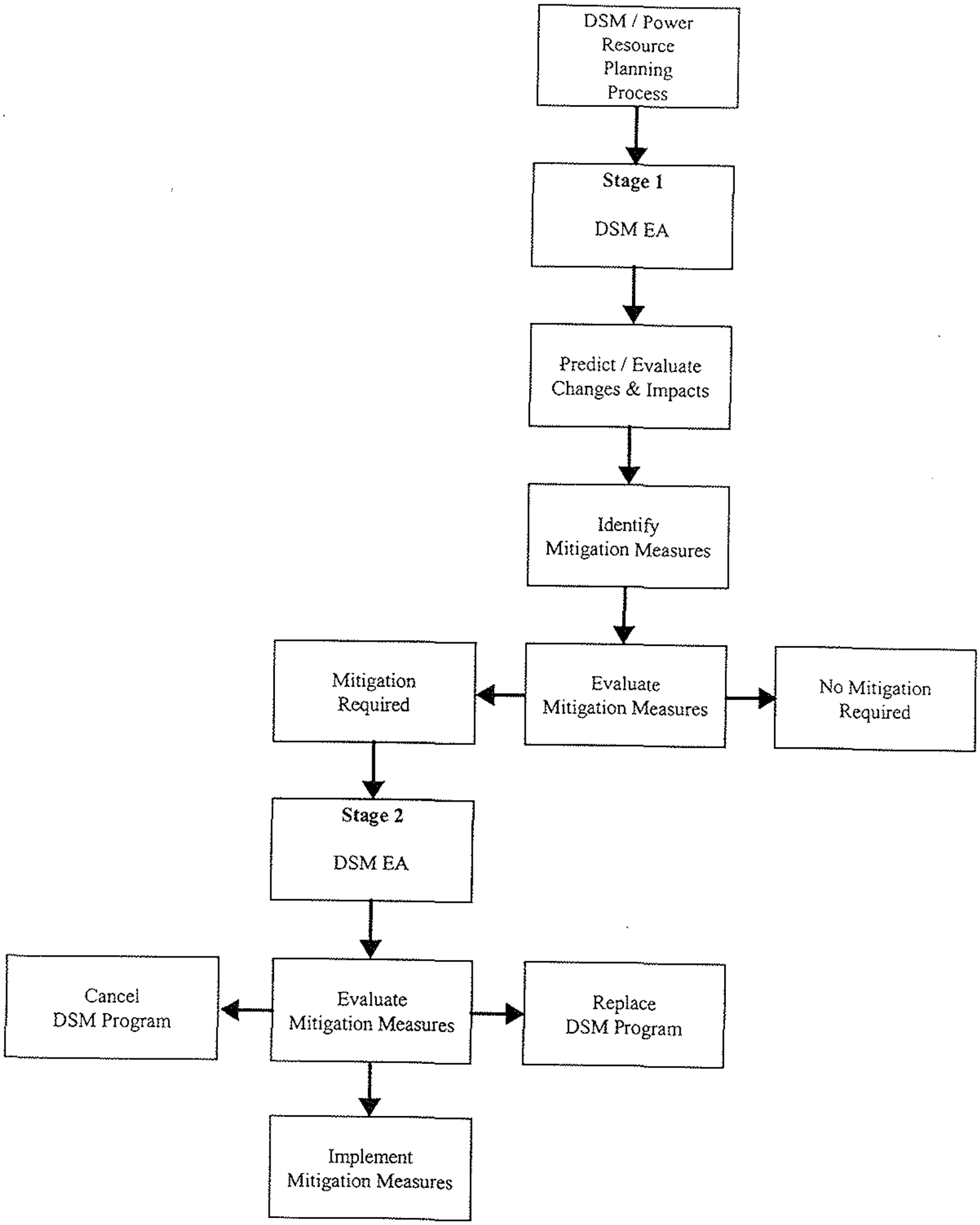

Figure 1: DSM EA Framework

The DSM EA framework was tested by application to the Energy Efficient Lighting Program[3] of Manitoba Hydro. It became apparent that caution is required when determining the significance of environmental changes. This is primarily due to the different contexts under which these changes occur. The spatial distribution of released contaminants, or the medium into which the release occurs, may vary, making comparison of environmental changes difficult. A more definitive determination of impacts involves determining impact thresholds of environmental components or the distribution of contaminants. A rigorous DSM EA would attempt both.

The approach of estimating impacts from environmental changes also presented difficulties and in the test case some additions were required. This more detailed approach to impact prediction went beyond the use of estimates of generic environmental changes to include a description of impact processes and effects. This provided a better understanding of the potential impacts resulting from the predicted environmental changes. A description of the biological and health effects, as well as the pathways of mercury released into the environment from the disposal of lamps, was performed. In addition, some benefit was obtained by discussing regulatory levels used by other jurisdictions. This provided insight into the stability of provincial regulatory levels that could alter the need for mitigation measures in the future.

Inability to predict the cumulative environmental changes over time was a deficiency of the test assessment case. The trial predicted additive changes due to the program and other activities, but failed to determine losses or predict net changes of contaminants over time. An understanding of the complete contaminant flux over time would be necessary to determine cumulative changes. This will prove difficult. It was possible to calculate the contribution of mercury-containing lamps to the provincial waste stream from available national data. In addition, predictions of trends of mercury released from specific parts of the waste stream (e.g., dental waste) were estimated from US data (Franklin, 1992). While global and national data are available to estimate the industrial and natural sources of mercury, there is a lack of local or regional data that could be used for impact prediction. In many cases a similar absence of data exists with respect to other environmental contaminants.

The identification of mitigation methods and examples of mitigation efforts effectively presented a range of options for further study. These methods included the landfill and incineration of lamps, as well as recycling and reclamation, and the source reduction of mercury in lamps. Examples of mitigation in California, Minnesota, and Sweden were discussed in the trial EA. The limited discussion of mitigation costs and the problems and possibilities for application in the province of Manitoba was useful in indicating whether the further evaluation of mitigation warranted the next stage of the EA.

Conclusions

DSM programs produce mainly positive environmental impacts. However, these programs have the potential for negative impacts through the introduction, or accelerated introduction, of new technologies or practices. Few of the impacts resulting from DSM programs cannot be mitigated if they are appropriately identified. Since the success of DSM programs is directly related to public participation, the evaluation and mitigation of negative impacts, or the evaluation and enhancement of positive impacts, can be important to the success of these programs. In those cases where such impacts are anticipated, or where the positive impacts need to be more clearly determined, some form of EA is necessary before utilities establish certain DSM programs.

Several utilities have responded to this need. They have applied a number of different types of EA to their DSM programs. Primarily, EA has been used to determine environmental impacts, but the scope of each has differed

3/ This DSM program promoted the use of sodium vapour, fluorescent, and high intensity discharge lamps using various financial incentives.

from broad application to all power resources to evaluation of only a single DSM program. In some cases EAs gave consideration to only one issue or type of impact, in others, to consideration of several impacts.

Analysis of a number of alternative EA processes resulted in the identification of a multi-staged EA framework, with a limited scope, that provides information about the environmental impacts of DSM programs, and their mitigation, in an incremental way. This limits the need for significant additional resources and meets the criteria for effective EA as identified by major utilities and the literature, respectively.

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