DISTRIBUTIVE FAIRNESS MEASURES FOR SUSTAINABLE PROJECT SELECTION

BY

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ABSTRACT

This work develops general fairness measures that may be used as criteria for sustainable project selection. Sustainable development, fair allocation norms, and empirical distance-based measures of fairness. and their evaluation are discussed. Generalized fairness measures are developed and extended for both intratemporal and intertemporal fairness comparisons. A preliminary application of the extended distance based fairness measures is then performed for a case study of the selection of an electricity supply project. The case study involves selecting between a dispersed diesel energy supply and centralized energy supply with land line energy distribution. Due to data limitations, the perceived fairness is measured in terms of the annual energy costs per megawatt-hour that result from implementing each alternative. The applied fairness measures indicate that intratemporal fairness, in terms of the distribution of user unit costs, may be increased by choosing the land line alternative and that there is no significant difference among alternatives with respect to intertemporal fairness. These results provide limited insight into the energy supply problem, however, and it is suggested that further analyses should be conducted when information on the environmental impacts and reliability of power supply for each of the alternatives become available.

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Chapter 1:

INTRODUCTION

1.1 General

In the process of project selection and implementation a best compromise solution for a problem is achieved often by considering conflicting criteria, or objectives, and after the project is implemented it may be modified as appropriate based on initial impacts and additional information as this becomes available (United Nations, 1988). Project selection criteria may consider economic, financial, biophysical, and social impacts of a given project alternative. Simonovic *et al.* (1994) recently identified three additional criteria for including sustainability in project selection. These are: intergenerational equity, project and impact reversibility, and risk management over time. While common project selection criteria such as economic efficiency are widely applied, applications of project selection criteria based on equity, or fairness, are less common. This work develops intratemporal and intertemporal fairness measures that may be used in project selection. These measures are applied to a case study, known as the North Central Project, that evaluates alternative electrical power supply technologies required to meet the forty-year load forecast for seven northern Manitoba communities.

Fairness considerations of a project's impacts are important for two reasons. First, a decrease in the fairness of a project's impacts may decrease social well being through the introduction of tension and conflict among individuals within a society, that may in turn, decrease individual well being. While a project's mandate may be to secure an improvement in social and individual well being, if these project related impacts are distributed unfairly, the mandate's objectives may not be fully realized. Furthermore, if civil engineers are aware in advance of fairness issues, which are often a primary concern for decision makers, projects may be better designed for their intended purpose. Second, decreases in fairness may increase the drive for interested and affected individuals to form an organized effort to resist the project from being implemented. Therefore, the more unfair a project's impacts are perceived, the more likely it is that individuals may oppose the project, and that the risk of implementation failure would increase.

1.2 Problem

Civil engineering projects may be seen as an allocation of different impacts that may originate during the construction and operational phases of a project's design life.

Impacts may persist after the project has been dismantled, may affect other regions, and may act on a local, regional, or global scale. An example in water resources engineering is the construction of a structure which controls both spatial and temporal quantities of surface water in order to harness the biophysical system's potential energy to further the well being of individuals within the region. The spatial and temporal manipulation of surface water from its natural state may distribute impacts within the region that may be seen as unfair by affected or interested groups of people. As tensions aroused by an unfair allocation of project related impacts may decrease well being, the project may therefore not fully achieve its intended purpose.

As a review by Marsh & Schilling (1994) shows, a common approach to the empirical measurement of distributive fairness is performed by using distance based fairness measures. A distance based measure is a function of the weighted distance between a distribution of actual impacts of a project and a distribution of ideal impacts. While many different distance based fairness measures exist, a consensus does not exist as to which are the most suitable distance based fairness measures. If these measures are to be used as distributive fairness criteria for project selection, the suitability of these different measures must be addressed. Furthermore, if these measures are to be used as criteria for sustainable project selection, they must be compatible with the notion of sustainability over time.

1.3 Scope

Distributive fairness measures that may be used as criteria for sustainable project selection are developed in this work. The objective of Chapter 2 is to review the literature in order to answer initial research questions and to identify key research questions which are further addressed in the following chapters of this work. The initial research questions addressed in Chapter 2 are: What is project selection?; What are key sustainability issues relating to fairness?; What is fairness in a distributive situation?; What distance based measures have been used to measure distributive fairness?; Have any of these measures been evaluated?; If so, on what bases?; and How have they been applied in actual case studies? While other methods of measuring fairness may exist, such as envy or utility based techniques, this work focuses only on the distance based fairness measures as defined by Marsh & Schilling (1994).

The objective of Chapter 3 is to apply the information obtained in the literature review in order to identify acceptable distance based fairness measures which may then be examined in more detail. A set of required principles and characteristics for distance based distributive fairness measures are compiled and for hypothetical impact distribution magnitudes, several measures that meet these requirements are identified. These measures may be extended to account for temporal issues which relate to sustainability. The objective of Chapter 4 is to formulate generalized aggregate distance based fairness measures that may be used as criteria for sustainable project selection. Sources of uncertainty relating to these measures are briefly discussed.

Chapter 5 discusses the application of the generalized distributive fairness measures to a case study involving a choice between two different power supply technologies for a number of northern Manitoba communities. The alternatives for this problem are dispersed diesel generation and hydropower generation with land line distribution, which must meet a forty-year load forecast for the communities. For each alternative, this work considers the annual forecasted average unit energy cost, in 1993 Canadian dollars per megawatt-hour (1993$/MWh/Year) to consumers within the communities as the impacts that are analyzed in terms of distributional fairness. Further comparisons of other biophysical, sociocultural, and economic impacts that result from each alternative would be required for this problem before a given alternative may be selected. However, the measures presented here may be applied should further meaningful impact forecasts become available. Finally, a discussion of the application and conclusions are given. Chapter 6 summarizes the major findings of this work and offers suggestions for future research.

Chapter 2:

LITERATURE REVIEW

The literature reviewed here addresses eight initial research questions and identifies the key issues which are the focus of the following two chapters of this thesis. The initial research questions addressed are: What is project selection?; What are key sustainability issues relating to fairness?; What is fairness in a distributive situation?; What distance based measures have been used to measure distributive fairness?; Have any of these measures been evaluated?; If so, on what basis?; and How have these distance based measures been applied in actual case studies? The literature review is organized in two sections, namely Distance Based Fairness Measures, and Sustainable Development and Project Selection.

2.1 Distance Based Fairness Measures

In general, groups of individuals evaluate the fairness of a distributive situation by a social comparison process in which each group compares what is received to what it feels it should receive. Blalock (1991: 207) states that in

> ". . . considering the reactions of the several parties to any allocation process we need to take into consideration their perceptions and interpretations concerning the fairness of both the procedures that have apparently been used and also the outcomes or resultants of these procedures."

The procedural aspects of fairness perceptions, such as public participation in decision making, are important as this process helps to make outcomes more socially legitimate. Legitimacy is a key concern for effective governance. Authors such as Deutsch (1975), Arthur & Shaw (1978), Blalock (1991), and Almond (1995) indicate that groups of individuals may evaluate the fairness of a distribution from two general standpoints. First, a group's perception of fairness may be influenced by the procedures used by the allocator such as the qualification of the allocator, the rules the allocator follows, and the timing of the process. Deutsch (1975: 143) states that perceived unfairness

> ". . . can be aroused in relation to the values underlying the distribution of benefits and harms, the rules by which the values are operationalized (into allocation rules), the implementation of the rules, or the procedures for determining which values, rules, or practices shall be employed."

Deutsch also highlights the importance of procedural aspects because if the procedure is seen as unfair the outcome may likely be seen as unfair also. Second, groups of individuals may form a perception of the fairness of a distributive situation based on the outcome, regardless of the process used by the allocator. Such discussions lend themselves to the first question to be addressed in this literature review, namely, What is a fair allocation? A review of the literature (Deutsch, 1975; Arthur & Shaw, 1978; Young, 1994; Almond, 1995) indicates two common approaches for identifying the fairness of the outcome of a distributive situation that may be compatible with distance based fairness measures and, in this work, these two are referred to as the norm-based approach and the normative approach. Other approaches for identifying a fair allocation are reviewed by Young (1994) and Almond (1995).

The norm-based approach focuses on three different fair allocation norms that groups may employ to evaluate the fairness of a distribution of benefits and harms: equality, need, and proportionality. An equal distribution may be seen as fair when there is no basis to differentiate among groups. However, situations may arise where groups are different and one group may need more of what is being distributed than another. For this reason, the distribution of benefits according to how much each group needs is often proposed in addition to equality. The concept of need is not widely addressed in the literature reviewed and requires further investigation. Almond (1995) states that the determination of how needy a group is may be addressed by examining statistics such as infant mortality or life expectancy. An approach that only considers needs however, ignores differences in how much each group contributes towards receiving a given benefit or harm.

The third allocation norm, known as proportionality, focuses on differences among groups and requires that each group should receive goods in proportion to what that group deserves. How much a group deserves, also referred to a group's input, is problem specific and many factors have been considered as inputs (Deutsch, 1975 and Cook & Yamagishi, 1983). Inputs may be multidimensional and classified as either contributions or attributes (Cook & Yamagishi, 1983). Contributions may include factors such as effort expended or time spent on a task. Attributes are specific to each group and include characteristics such as: age, race, occupation, and gender. The authors feel that the choice of which attribute is important is greatly influenced by cultural beliefs. They also state that, ideally, contributions should be used as an input rather than attributes because contributions such as effort and performance are more directly related to the input-outcome relationship.

Cook & Yamagishi (1983) also distinguish between fixed settings and variable settings. In fixed settings, there is a finite amount of what is being distributed and in this setting, both attributes and contributions are likely to be perceived as relative inputs. In variable settings, there is a limitless quantity being distributed, there is a more direct relationship between inputs and outcomes, and thus contribution may be perceived as the most relevant input. The definition of proportionality may be problematic if each group's input cannot be assessed or if the effect being distributed cannot be divided. Young (1994) discusses methods to overcome problems of indivisibility such as conversion, rotation, and randomization.

The relative importance of each fair allocation norm is identified by Deutsch (1975) and Blalock (1991) with some success. Deutsch (1975) proposes that proportionality would prevail in economically competitive settings, equality would prevail in solidarity orientated settings, and need would prevail in caring settings. Additionally, Deutsch (1975: 145) states that proportionally, ". . . over the long run, is likely to be dysfunctional for groups, economically as well as socially." By allocating in proportion to one's contribution, Deutsch states that people with power may bias the system toward disproportionate awards. Also, a proportionality based allocation may propagate economic values into all aspects of social life that may result in a loss of quality of life (Deutsch, 1975). Blalock (1991) proposes a generalized model that consists of 42 causal variables that may be used to determine differential emphasis placed on the three different allocation norms by allocators and groups. For example, a greater emphasis on proportionality may result in situations when groups have a self-serving bias, when influential groups favor their own qualifications, and when there is a possibility to modify beliefs. A greater emphasis may be placed on need when groups do not have a self-serving bias, when the item being distributed is scarce, and when groups feel that the needy are in such a position through no fault of their own. A greater emphasis may be placed on equality when groups do not have a self-serving bias, when solidarity is important, when the competitors are indifferent to receiving the item being distributed, and when there is little information available to the allocator.

The second common approach to evaluate the fairness of a distributive situation employs a normative theory of distributive justice. Authors such as Arthur & Shaw

(1978) and Young (1994) briefly mention the three fair allocation norms describe above and state that these are also used in the more complex normative approaches. These authors highlight common Utilitarian, Rawlsian, and Libertarian philosophies. A classic Utilitarian philosophy, advocated by Mill (1861), states that a just distribution will be a distribution that maximizes the total satisfaction of all individuals. Classical Utilitarianism, usually operationalized in terms of the Greatest Good Principle, requires that the best distribution results under the greatest sum of satisfaction or, utility. Utilitarianism is often criticized as a theory of justice because it may favor situations in which a few may pay a high price while many may benefit little. Additionally, the concept of utility is often criticized because one person's utility is not readily comparable to another person's utility. A Rawlsian philosophy, based on the work of Rawls (1971), states that a just distribution will be the least unequal distribution of primary goods that makes the worst-off person as best-off as possible. Primary goods are defined by Rawls as means to achieve satisfaction and include factors such as income, power, and opportunity. A Rawlsian approach is usually operationalized by employing the Maxmin Principle which requires that the worst-off group be made as well-off as possible. Libertarians, such as Nozick (1974), state that the just distribution is the distribution that does not violate any individual's rights.

Issues related to distance based fairness measures include: What distance measures are commonly used?; Have these measures been evaluated regarding their applicability?; If so, on what bases?; and How have these measures been applied? Marsh & Schilling (1994) review distance based proportionality and equality measures, commonly referred to as equity measures, that are frequently used in facility location analysis. They define equity as the fairness of the impacts that result from a siting decision, as perceived by affected groups of similarly situated individuals. A distance based fairness measure is a weighted sum of the distance between a distribution of ideal points and a distribution of actual points. The authors suggest that while grouping is problem specific, similarly situated individuals may be aggregated into groups by a spatial basis, demographic basis, physical basis, temporal basis, or combination of bases. Additionally, tools such as cluster analysis and pattern recognition techniques may also be useful for group definition. The authors review twenty distance measures found in economics, sociology, social psychology, management science, and engineering literature.

Regarding the evaluation of various distance based fairness measures, Marsh & Schilling (1994) note a lack of consensus in the literature as to which distance based fairness measure is appropriate in a given situation and mention several common desirable characteristics. These characteristics are analytic tractability, appropriateness, impartiality, adherence to the Principle of Transfers, adherence to the Principle of Scale Invariance, satisfaction of Pareto Optimality, and the ability to be normalized. Some of these characteristics are discussed in more detail by Alker & Russett (1964), Atkinson (1970), Champernowne (1974), Kolm (1976), Allison (1978), Mulligan (1991), and Mandell (1991). Marsh & Schilling (1994) note that there is no consensus in the literature on which characteristics are required, and which characteristics are simply desirable, for a good distance based fairness measure.

Marsh & Schilling (1994) propose an organizational framework to facilitate future evaluation of distance based equity measures that consists of sorting measures based on three factors: reference distribution, scaling, and distance exponent. The authors describe a reference distribution as being a specific or desired effect level for each group, or the perceived fair distribution. Possible types of reference distributions are peer, mean, or attribute based distributions. Peer and mean based reference distributions reflect the equality fair allocation norm where peer reference distributions refer to comparisons among all peers and mean reference distributions refer to comparisons with the mean impact for all peers. From this point on, measures of this type are referred to as measures based on an equality comparison approach. It is important to note that of the twenty measures reviewed by Marsh & Schilling (1994), thirteen of these measures are based on an equality comparison approach. Marsh & Schilling (1994) also describe an attribute reference distribution as being specific to each group and being based on, for example, the level of social need, desire, demand, social merit, or population of the group. An attribute based reference distribution may be seen to be based on the proportionality or need fair allocation norm. Thus, from this point on, measures of this type are referred to as measures based on proportionality or need comparison approaches. Scaling is described as being commonly used when group sizes differ to account for large differences in the size of the distances measured. If scaling is performed, it is typically based on a normalization of distances or a weighting based on the different attributes of the groups. Commonly used distance exponents are either one, two, or infinity. As the magnitude of the distance exponent increases from one, a greater weight is placed on deviations from the reference distribution. Marsh & Schilling (1994) conclude by stating that a universal distance based fairness measure does not exist and that more work needs to focus on defining selection criteria that may be used to determine what is a good equity measure and examining the conflict between equity and efficiency.

The work of Marsh & Schilling (1994) is an organized attempt to form a common framework for using distance based fairness measures defined as some weighted distance between an actual state and an ideal state. However, a few points are not stressed sufficiently in this work. First, discussions of an ideal, fair, or just distribution are not addressed in Marsh & Schilling (1994). These are considered in the domain of distributive justice, and have been discussed since philosophers such as Aristotle (see Thomson, 1985).

Second, distance based measures are used by social psychologists and economists to empirically measure how fair or just, a distributive situation may be perceived by affected individuals, and they refer to these empirical measures as inequality and inequity measures, respectively. They have different perspectives on what constitutes a fair allocation. Distance based measures, employed by economists to measure equality, may be thought of as a norm-based approach to fairness measurement and are based on an equality fair allocation norm. In contrast to this, distance based measures employed by social psychologists, are based on both equality and proportionality norms following the work of Adams (1963) who defined equity in this manner. These attitudes, which are not explicitly discussed by Marsh & Schilling (1994), may have important implications in the evaluation of distance based fairness measures. For example, Marsh & Schilling (1994) state that a desirable characteristic of a good equity measure is that it satisfy the Principle of Transfers. However, the Principle of Transfers, developed by Pigou (1912) and Dalton (1920) for equality measures, is associated with an equality norm and has nothing to do with a proportionality norm, a persons input, or contribution.

Third, definitions of distance based fairness measures reflecting a need based fair allocation norm are not reported. As the literature indicates (Deutsch, 1975; Blalock, 1991; and Almond, 1995) proportionality, equality, and need fair allocation norms are employed by groups in fairness evaluations to varying degrees, the introduction of need based comparison measures may make distance based fairness measurement more analogous to that of the norm-based fair allocation approach discussed above.

A diverse literature on the application of distance based fairness measures in actual decision making situations exists. Examples in water resources engineering and management science include Brill (1972), McAllister (1976), Cohen (1978), and Sampath (1991). Brill (1972) examines both efficiency and equity aspects of waste discharge water quality management programs for the Delaware Estuary. He defines equity as the equality of removal efficiencies among dischargers and uses three different distance based fairness measures. These are the absolute deviation from the mean waste treatment level, the range between the maximum and minimum waste treatment levels, and the maximum of the waste treatment levels. McAllister (1976) presents a theoretical framework to evaluate fairness and efficiency for both delivered and non-delivered urban public services to examine the implications of service size and service spacing alternatives. He defines fairness as the degree of equality and operationalizes it by comparing standard deviations of the distances between service centers and demand points. Cohen (1978) discusses a multi-objective river basin development plan for the Rio Colorado River in Argentina in which a regional allocation objective function is formulated in addition to an efficiency objective function. The regional objective function is to minimize the mean absolute deviation of water withdrawals among four provinces in a region. Cohen also mentions that, for this case study, the decision makers did not agree with an equality norm nor would they reveal their preference for an alternative fair allocation norm. Sampath (1991) employs the Theil Entropy Coefficient to examine fairness in the distribution of access to irrigation water between agricultural groups in India. Sampath also mentions that an egalitarian policy may be compatible with a Rawlsian based irrigation policy. Egalitarianism, a popular philosophy in welfare economics, is another possible normative approach and requires an equal distribution of welfare among individuals.

McKerlie (1989) addresses the intertemporal application of distance based fairness measures and discusses temporal aspects in fairness evaluations. In comparing impacts on two people, he considers whole lives, simultaneous segments of lives, and corresponding segments of lives comparisons. The whole lives approach compares the total impact acting on each person's life. This approach may not reflect differences that occur during some time period of the different lives. The simultaneous segments approach compares the impacts acting on the individuals in some mutual time period in both lives. The corresponding segments approach compares the impacts acting on each life in the same stage of the respective lives.

2.2 Sustainable Development and Project Selection

According to Munasinghe & McNeely (1995: 20), throughout evolution "... the populations that survived were by definition those that had a sustainable relationship with their environment; that is, unsustainable behavior led to displacement or extinction of the population or to a change in human behavior." However, as David Suzuki (Aberly, 1994: 2) states, "this century, human societies have undergone explosive change as a result of technological innovation, increased population, higher material demands and consumption, a massive move to cities, and the globalization of economies." These driving forces, processes, and movements have caused ecological damage on all scales that was severe enough to gain the attention of the international community and the result is an extremely large and diverse literature involving the harmonization of human activity with environmental protection.

Morita *et al.* (1993) review the origin and meaning of sustainable development and note that in 1980, sustainable development was used for the first time by the World Conservation Strategy who advocate three ways to achieve better development. These are: the maintenance of a basic natural system, the preservation of genetic resources, and the sustainable use of the environment. They also review forty definitions of sustainable development from different disciplines and find that these are different from one another but may be classified into three different categories. These categories are: definitions that stress the importance of natural conditions, definitions that stress equity, or fairness, among generations, and definitions that stress social justice and quality of life.

Additionally, authors such as Lele (1991) and Dovers & Handmer (1993) also mention a lack of consistency in the definition of sustainable development and several inconsistencies and paradoxes with the concept. Holdren *et al.* (1995: 4), in discussing the biogeophysical aspects of sustainability, note that ". . . much of the analysis and discussion of this topic remains mired in terminological and conceptual ambiguity about the facts and practical implications." Morita *et al.* (1993) note the term sustainable development gained greater popularity in 1987 when the Brundtland Commission (WCED, 1987) defined sustainable development as ". . . development that meets the needs of the present while not compromising the ability of future generations to meet their own needs." The Brundtland Commission's definition of sustainable development stresses the consideration of the needs of the present generation and of future generations, and has prompted others (Young, 1992; Beltratti, 1995; Munasinghe & Shearer, 1995) to promote equity as one of a number of objectives required for sustainability.

Munasinghe and McNeely (1995) organize approaches to sustainable development by the common disciplines that discuss the concept, namely: economics, ecology, and sociology. Economists relate sustainability to the preservation of productive capital stock where efficiency, growth, and stability of capital are main objectives. Ecologists are concerned with the sustainability of the biophysical subsystem and focus on the biophysical system's resilience. An ecologist's perspective of sustainable development includes considerations such as the maintenance of biodiversity, the sustainable use of natural resources, and the assurance that human activity does not exceed an ecosystem's carrying capacity. Biodiversity, according to Munasinghe & McNeely (1995), includes the genetic taxonomic and ecological variability among living organisms; that is the variety and variability within species, between species, and within the biotic components of ecosystems. The sociocultural approach focuses on sustaining the sociocultural system through the adaptability and preservation of diverse social and cultural systems. The main objectives are thought to include the reduction of poverty, the promotion of public consultation and empowerment, and the preservation of culture and heritage. Intragenerational equity, or fairness within a generation, and targeted relief and employment are to provide economic and social linkages according to these authors although these are not discussed in detail. The economic and biophysical linkages are to be achieved by economic valuation techniques and the internalization of externalities. The social and biophysical linkages are to be achieved through intergenerational equity, or fairness between generations, and grass-roots participation considerations. Three reoccurring themes appear in all literature reviewed that discuss sustainable development. First, sustainability discussions usually focus on developmental impacts to social, economic, and biophysical systems because sociologists, economists, and ecologists respectively, have discussed sustainable development the most. This may indicate that sustainable project selection criteria should examine social, economic, and biophysical project related impacts rather than, for example, only the economic impacts of a given project alternative. Second, discussions of intragenerational and intergenerational equity in the sustainability literature are very limited and do not mention any of the literature on fair allocation or distance based fairness measures discussed in the previous section. Thus, the incorporation of these considerations may more fully develop the concept of sustainable project selection especially if one chooses to use a definition of sustainable development, such as the Brundtland Commission's, which according to Morita *et al.*, stresses the importance of fairness between and among generations.

Nachtnebel *et al.* (1994), Simonovic *et al.* (1995), and Matheson *et al.* (1997) discuss criteria for sustainable project selection. According to the United Nations (1988), project selection and implementation negotiates a best compromise decision where conflicting objectives exist, initiates the project, and modifies it as appropriate based on initial impact and additional information as it becomes available. The combining of these impacts into a measure of relative worth so that the alternative projects can be ranked clearly involves making compromises among conflicting objective values. Typically, multi-objective project selection techniques are used to make comparable objectives which are initially non-commensurate so that the project may be selected that achieves each of the objectives to some degree. For a detailed discussion of multi-objective techniques, see Cohen (1978) and Bogardi & Nachtnebel (1994). According to Cohen (1978) and the United Nations (1988), project selection is one step in the project planning cycle. The project planning cycle consists of five inter-related and iterative tasks (United Nations, 1988). These are: project identification; project assessment; project screening; project selection and implementation; and project monitoring and modification. Project identification involves the creation of alternative activities or projects that appear to satisfy development objectives, that will be financially feasible, and that are institutionally acceptable. Development objectives may be categorized as financial, economic, social, and environmental. Project assessment predicts and evaluates all alternative project impacts, costs, and benefits to all affected individuals to the extent possible. According to Erickson (1994), impacts may be seen as direct, indirect, or cumulative. Direct impacts are changes in environmental components and processes that result immediately from a project related activity or action. Indirect impacts are changes in environmental components and processes that are consequences of direct impacts. Cumulative impacts are the aggregates of direct and indirect impacts resulting from two or more projects in the same area or region. Cumulative impacts are important because, while a given project may have a small incremental impact on the environment, the cumulative loss in the region may be seen as significant. Project screening is the ranking of alternative competing projects and the identification of projects which seem to merit serious consideration by those responsible to the extent possible. This may be accomplished by techniques such as the development of Information Matrices, Scorecard Display Techniques, and Computer Graphic Displays (United Nations, 1988). Project Monitoring and Modification requires the monitoring of project impacts and modifying its design and/or operation as desired to reduce adverse impacts and enhance beneficial impacts.

Chapter 3:

DISTANCE BASED FAIRNESS MEASURES

As discussed in Chapter 2, works in the disciplines of economics, engineering. management science, and social psychology have empirically measured the fairness of a distributive situation by using a variety of distance based fairness measures. However. a consensus on which measure is the most appropriate, and a method with which to select an appropriate measure from among a set of possible measures, are not given in the literature. Therefore, this chapter discusses the evaluation of distance based fairness measures in more detail given the desirable principles and characteristics found in the literature, proposes a framework for their evaluation, and evaluates the appropriateness of the twenty measures discussed by Marsh & Schilling (1994) based on this framework. Only appropriate measures, as determined here, are then be considered for the development of sustainable project selection criteria presented in Chapter 4.

3.1 Classification

It is proposed in this work that the generalized framework for classifying distance based fairness measures in Marsh & Schilling (1994) be modified to explicitly accommodate the three types of fair allocation norms discussed in Chapter 2. Recall that the three fair allocation norms are based on proportionality, equality, and need. Distance based fairness measures that account for deviations from an allocation that is proportional to a group's input are referred to hereafter as proportionality based measures. Proportionality based measures compare an actual impact that acts on group i, $E(i)$, to $A(i)$, the amount of that impact that group i deserves to receive; or $\overline{A}$, the average deserved impact of all groups. Distance based fairness measures that account for deviations from an equal allocation are referred to hereafter as equality based comparison measures. Equality based measures compare an actual impact that acts on group i, $E(i)$, to either $E(j)$, the actual impact that affects group j; or $\overline{E}$, the average of the actual impacts affecting all groups. Distance based fairness measures that account for deviations from an allocation that allows the needs of each group to be met are referred to hereafter, as need based comparison measures. As no need based measure is given in the literature, and since one's need may be expressed as a constant similar to one's input toward receiving an impact or one's deserved impact, measures similar to those of proportionality based measures may be used as need based measures. In this manner, need based measures compare an actual impact that acts on group i, $E(i)$, to $Z(i)$, the amount of impact that allows group i to meet its needs or $\overline{Z}$, the average of what all groups require to meet their needs. Of course, this is only one way of measuring the deviation from meeting needs and other approaches may be possible.

Distance based fairness measures discussed by Harris (1983) and Marsh & Schilling (1994) are the: Center, Variance, Mean Absolute Deviation, Sum of Absolute Deviations, Range, Coefficient of Variation, and Variance of Logarithms measures; two variations of the Sum of Absolute Deviations (Erkut,1992), one variation of the Mean Absolute Deviation (Erkut,1992), and one variation of the Range (Brill,1972); the Gini Coefficient, Hoover Concentration Index, Coulter Measure, Walster Measure, Equal Excess Formula, Adams Formula, Schutz Coefficient, and Theil Entropy Coefficient; and one variation of the Coulter Measure proposed by Mayhew & Leonardi (1982). These measures are presented in Tables 3.1 and 3.2 according to whether they are primarily based on the proportionality or the equality norm, respectively. Potential need based measures may be viewed as having the same structure as the proportionality based measures presented in Table 3.1 at this point, but here $A(i)$ would be replaced by $Z(i)$ and $\overline{A}$ would be replaced by $\overline{Z}$. These potential need based measures are not shown as to avoid unnecessary repetition at this time.

The Center measure does not correspond to any norm-based fair allocation approach and is thus eliminated from further consideration. When considering the framework of Marsh & Schilling (1994), potentially appropriate proportionality and need based measures have an attribute based reference distribution. Potentially appropriate equality based measures have peer or mean reference distributions and do not contain any reference to an attribute. Equality based measures that have a mean reference distribution have, in actuality, a peer reference distribution as the mean is the average of all peer impacts. Recall from Chapter 2 that while both peer and mean based reference distributions reflect the equality fair allocation norm, attribute based reference distributions may reflect a proportionality or need fair allocation norm. Peer reference distributions refer to comparisons among all peers and mean reference distributions refer to comparisons with the mean impact for all peers. An attribute based reference distribution is specific to each group and may be, for example, the level of social need, desire, demand, social merit, or population of the group. An attribute based reference distribution may be seen to be based on the proportionality or need fair allocation norm.

Table 3.1: Potential Proportionality and Need Based Measures

Name	Measure	Fair Allocation Norm	Reference Distribution
Adams Formula	$\sum_{i=1}^{I}\sum_{j=1}^{I}\left\|\frac{E(i)}{A(i)}-\frac{E(j)}{A(j)}\right\|$	Proportionality (and Equality)	Peer
Walster Formula	$\sum_{i=1}^{I}\left\|\frac{E(i)-A(i)}{A(i)}\right\|$	Proportionality	Attribute
Equal Excess Formula	$\sum_{i=1}^{I}\left\|E(i)-A(i)\right\|$	Proportionality	Attribute
Coulter Method	$\left[\frac{1}{I}\sum_{i=1}^{I}\left[\frac{E(i)}{\overline{E}}-\frac{A(i)}{\overline{A}}\right]^2\right]^{½}$	Proportionality	Attribute
Coulter Method #1	$\sum_{i=1}^{I}\left[\frac{E(i)}{A(i)}-\frac{\overline{E}}{\overline{A}}\right]^2$	Proportionality (and Equality)	Mean (and Peer)
Hoover Concentration Index	$\frac{1}{I}\sum_{i=1}^{I}\left\|\frac{E(i)}{\overline{E}}-\frac{A(i)}{\overline{A}}\right\|$	Proportionality	Attribute

Table 3.2: Potential Equality Based Measures

Name	Formula	Fair Allocation Norm	Reference Distribution
Variance Measure	$\sum_{i=1}^{I}\left(E(i)-\overline{E}\right)^2$	Equality	Mean (Peer)
Coefficient of Variation Measure	$\frac{\left(\sum_{i=1}^{I}\left(E(i)-\overline{E}\right)^2\right)^{½}}{\overline{E}}$	Equality	Mean (Peer)
Mean Absolute Deviation Measure	$\sum_{i=1}^{I}\left\|E(i)-\overline{E}\right\|$	Equality	Mean (Peer)
Schutz Index	$\frac{\sum_{i=1}^{I}\left\|E(i)-\overline{E}\right\|}{2I\overline{E}}$	Equality	Mean (Peer)

Table 3.2 (cont.): Potential Equality Based Measures

Name	Formula	Fair Allocation Norm	Reference Distribution
Variation #1 of the Mean Absolute Deviation Measure (Erkut, 1992)	$\underset{i}{Max}\lvert E(i)-\overline{E}\rvert$	Equality	Mean (Peer)
Sum of Absolute Deviations Measure	$\sum_{i=1}^{I}\sum_{j=1}^{I}\lvert E(i)-E(j)\rvert$	Equality	Peer
Variation #1 of the Sum of Absolute Deviations Measure (Erkut, 1992)	$\sum_{i=1}^{I}\underset{j}{Max}\lvert E(i)-E(j)\rvert$	Equality	Peer
Variation #2 of the Sum of Absolute Deviations Measure (Erkut, 1992)	$\underset{i}{Max}\sum_{j=1}^{I}\lvert E(i)-E(j)\rvert$	Equality	Peer
Gini Coefficient	$\dfrac{\sum_{i=1}^{I}\sum_{j=1}^{I}\lvert E(i)-E(j)\rvert}{2I^2\overline{E}}$	Equality	Peer
Range Measure	$\underset{i,j}{Max}\lvert E(i)-E(j)\rvert$	Equality	Peer
Variation #1 of the Range Measure (Brill, 1972)	$\underset{i}{Max}\,E(i)-\underset{j}{Min}\,E(j)$	Equality	Peer
Theil Entropy Coefficient	$\dfrac{\sum_{i=1}^{I}\lvert E(i)\log E(i)-\overline{E}\log\overline{E}\rvert}{I\overline{E}}$	Equality	Mean (Peer)
Variance of Logarithms Measure	$\dfrac{\sum_{i=1}^{I}\left(\log E(i)-\log\overline{E}\right)^2}{I}$	Equality	Mean (Peer)

3.2 Relevant Principles and Characteristics

When discussing equality measures. Temkin (1993) suggests that a lack of consensus on appropriate fairness measures may result from authors not knowing which distributive principles should be represented by each measure. He suggests that, in order to capture the notion of equality, one should determine the important principles, arrive at an accurate measure of each principle, and construct a measure so as to reflect the importance of each principle. Expanding on these ideas, it is proposed in this work that principles given in the literature be associated with proportionality, equality, and need fair allocation norms in this section so that each type of fairness measure may be evaluated in the next section of this chapter..

The literature reveals that distance based fairness measures are evaluated according to the following principles: Fundamental, Transfers, Scale Invariance, Additive, Weighted Additive, Maxmin, Impartiality, and Consistency in addition to analytic tractability, satisfaction of Pareto Optimality, and an ability to be normalized. Based on the work of Adams (1963), Harris (1983) cites the Fundamental Principle as a major requirement for all appropriate proportionality based fairness measures. The Fundamental Principle requires that when a group's relative outcome remains constant, the group's outcome should increase monotonically with that group's input. Harris defines a group's relative outcome as the comparison of that group's outcome to their input where, an input is that which a group perceives as a contribution or attribute towards receiving some impact, and an outcome is the impact that this group perceives as receiving for this input. This means that outcomes should be distributed in proportion to inputs. In the context of sustainable project selection, a group's inputs are seen to be either attributes or contributions towards receiving a given project related impact. A group's outcomes are the project related impacts that affect that group.

The Principle of Transfers, developed by Pigou (1912) and Dalton (1920), requires that measures show an improvement in equality when a unit amount of some benefit is transferred from someone better off to someone worse off. The Principle of Scale Invariance is also strongly supported in the literature. Measures satisfying the Principle of Scale Invariance must show that relative differences in impacts matter and not absolute differences. Thus, if a situation occurs in which, for two impact distributions, one distribution is a multiple of the other, a scale invariant equality measure would calculate the same deviation from equality for both distributions as the relative differences remain the same.

Temkin (1993) proposes the Maxmin, Additive, and Weighted Additive Principles as principles of equality. The Weighted Additive Principle requires equality to be measured by summing up all differences among individuals and attaching a weight to these differences. The Additive Principle may be seen to be a special case of the Weighted Additive Principle, it is the same except that, no additional weight is afforded to larger differences. The Maxmin Principle may also be seen to be a special case of the Weighted Additive Principle, it is the same except that, the largest possible weight is attached to the largest deviation from equality. Under the Maxmin Principle the equality measure would report the magnitude of the largest deviation.

It seems intuitive that all distance based fairness measures should be both Impartial and Consistent. Impartiality requires that fairness evaluations be based on what is being distributed and not on some other ordering or ranking while Consistency requires fairness evaluations to be made in a similar fashion among all groups. A measure that is not impartial may be a measure that is biased towards one group. In this work, an impartial measure examines all impacts among all groups. Consistency requires that, when a measure is applied to a distribution of impacts, the measure is applied in the same way for all groups.

The desirable characteristics suggested in the literature include analytic tractability, satisfaction of Pareto Optimality, and the ability to be normalized. A measure that is analytically tractable should be intuitive for the decision maker and be relatively easy for the analyst to apply. Pareto Optimality requires that, as one person is made better-off no one is made worse-off. Normalization requires that the magnitude of the measure be bounded between two values so as to facilitate the comparison of the magnitudes of measures for two or more different distributions. Fairness measures may also be bounded from some lower value up to some upper value to provide the decision maker with numbers that are comparable across alternatives.

As the Fundamental Principle is the only principle found in the literature related to a group's input, the Fundamental Principle from this point on, is regarded as a principle associated with a proportionality fair allocation norm. The Principles of Transfers and Scale Invariance have been discussed historically by economists in the context of equality and are not related to a group's input in any way. It should be stated that Temkin (1993) feels that deviations from equality matter more at lower positive impact magnitudes than at higher positive impact magnitudes. While the author of this thesis agrees with Temkin in part that deviations from equality matter more at lower positive impact magnitudes. the author believes that, as defined in this thesis, the issue of absolute difference relates more to a need based fair allocation norm than an equality based fair allocation norm. Therefore, from this point on, all appropriate equality based measures should satisfy the Principle of Transfers and the Principle of Scale Invariance, and these principles will be considered in the evaluation of appropriate equality based measures given in the next section. Principles relating to a need fair allocation norm were not found in the literature and future research efforts toward defining these must be initiated.

All proportionality, equality, and need distance based fairness measures are seen to satisfy the Weighted Additive Principle as the value of the exponent implicit in the equations presented in Tables 3.1 and 3.2 may take on any value. Therefore, it is proposed here that all fairness measures satisfy the Weighted Additive Principle. As all measures appear to satisfy the Weighted Additive Principle, this principle is not considered in the evaluation of appropriate measures given in the next section. The principles of Impartiality and Consistency are considered by Young (1994) and Almond (1995) to be central to fair allocation. The Impartiality, Consistency, and Weighted Additive Principles are considered in this work to associated with fairness in general and not specific to any one fair allocation norm. Thus, all distance based fairness measures, regardless of the fair allocation norm the measure may reflect, must therefore satisfy the Impartiality, Consistency, and Weighted Additive Principles. As all distance based fairness measures discussed here appear to satisfy the fairness principles, they are not considered further however, these principles may gain importance when considering the procedural aspects of fairness evaluations. For example, a survey designed to collect information on the relative importance attached to different fair allocation norms by groups should not exclude any group or attach more weight to a certain group's response. The characteristics of analytic tractability, satisfaction of Pareto Optimality appear to be more relevant to the application of the measure rather than the design of the measure itself and thus are not considered further.

3.3 Evaluation and Recommendations

While social psychologists, economists, and management scientists have made valuable contributions in the evaluation of distance based fairness measures much work remains. Harris (1983) reviews commonly used distance based fairness measures, known as equity measures, in social psychology, and concludes that equity measures are still evolving and that there is no single best measure. He examines seven measures of which three are also analyzed in Marsh & Schilling (1994): Adams Formula, Walsters Formula, and Equal Excess measure. The remaining four measures are variations on the three measures also examined by Marsh & Schilling (1994). Harris tests seven common equity measures and finds that, of the three equity measures also discussed by Marsh & Schilling (1994), only the Equal Excess Formula satisfies the three criteria required for a good equity measure. Four other measures not mentioned by Marsh & Schilling (1994) also satisfy the Fundamental Principle. These are the: Walster Formula #2, Moschetti Formula, Harris Linear Formula, and Harris Exponential Formula. Harris concludes by recommending the latter two measures and stating that while progress has been made in the search for a good equity formula, it is however an ongoing process. Allison (1978) evaluates the Relative Mean Deviation and Variance of Logarithms measures; and the Coefficient of Variation, Gini Coefficient, and Theil Entropy Coefficient. While all measures satisfy the Principle of Scale Invariance, the Relative Mean Deviation and Variance of Logarithms measures fail to satisfy the Principle of Transfers. Mulligan (1991) determines that while the Standard Deviation measure satisfies the Principle of Transfers, the Hoover Concentration Index does not. Mulligan does not evaluate the compliance of these measures with the Principle of Scale Invariance. Erkut (1992) shows that while the Sum of Absolute Deviations measure satisfies the Principle of Transfers, the Center and Range based measures do not. Mandell (1991) determines that the Center, Range, and Sum of Absolute Deviations measures fail both the Principle of Transfers and the Principle of Scale Invariance. These results conflict somewhat with Erkut's (1992) results for the Sum of Absolute Deviations measure.

While the above authors evaluate a given measure with respect to a given principle, they are not specific about how they evaluate a given measure nor do they provide any calculations. In addition, a comprehensive evaluation of these measures remains to be conducted. For a hypothetical data set, this section attempts to address these shortcomings by evaluating proportionality and equality based fairness measures according to the principles associated with each fair allocation norm as found in the previous section.

Table 3.1 contains six potential proportionality and need based fairness measures the Adams Formula, Walster Formula, Coulter Method, Variation #1 of the Coulter Method, Hoovers Concentration Index, and Equal Excess Formula. To evaluate the ability of these measures to satisfy the Fundamental Principle, consider a situation where group 1 has a input, $A(1)$, equal to -2 and an outcome, $E(1)$, equal to +2. Group 2 has an input, $A(2)$, equal to +4 and an outcome, $E(2)$, of -4. In this situation. Adams Formula calculates a magnitude of zero indicating that the situation is proportionately fair but, group 1 has acted in a negative manner and received a positive outcome while group 2 has acted in a positive manner and received a negative outcome. This is not a fair situation and a good proportionality based fairness measure should not say that it is. Thus, proportionality based fairness measures that satisfy the Fundamental Principle must calculate a deviation from a proportional allocation for this data set. Of the six potential proportionality based fairness measures Adams Formula, Coulter Method, variation #1 of the Coulter Method, and Hoover Concentration Index fail to satisfy the Fundamental Principle because these measures have a magnitude of zero when applied to the above scenario. The Walster Formula and the Equal Excess Formula satisfy the Fundamental Principle because these measures calculate deviations of 4 and 12, respectively for this scenario of inputs and outcomes.

Thirteen equality based measures found in Table 3.2 are evaluated with respect to the Principle of Scale Invariance and Principle of Transfers by considering a scenario where there are four groups that are affected by four impact distributions, Impact Distributions A-D, as shown in Columns 2-5 of Table 3.3. Impact Distribution A may be thought of as an arbitrary initial state. Impact Distribution B, shown in Column 3 has a magnitude that is exactly half that of Impact Distribution A. Equality based measures that satisfy the Principle of Scale Invariance will calculate the same deviation from equality for both Impact Distribution A and Impact Distribution B. Impact Distributions C and D, shown in Columns 4 and 5, have the same mean as Impact Distribution A, but are designed to represent a unit transfer from a better-off group to a worse-off group below the mean and above the mean, respectively.

Table 3.3: Impact Distributions Used to Evaluate Equality Based Measures

	Impact Distribution			
Group	**A**	**B**	**C**	**D**
1	2.0	1.0	3.0	2.0
2	8.0	4.0	7.0	7.0
3	6.0	3.0	6.0	7.0
4	4.0	2.0	4.0	4.0

The significance of comparing Impact Distributions A, C, and D is to determine if a given measure satisfies the Principle of Transfers which requires that a measure report an improvement if a unit amount of positive impact is transferred from a better-off group to a worse-off group. Thus, if a measure satisfies the Principle of Transfers it will calculate a smaller deviation from equality for Impact Distributions C and D than for Impact

Distribution A. The results of applying the thirteen equality based measures shown in Table 3.2 to the impact distributions listed in Table 3.3 are shown in Table 3.4. Measures that satisfy the Principle of Transfers for this data set are the Variance, Coefficient of Variation, Sum of Absolute Deviations, variation #1 of the Sum of Absolute Deviations, Gini Coefficient, Range, and variation #1 of the Range because; for each of these measures, the magnitudes in Columns 4 and 5 are less than the magnitude in Column 2 in Table 3.4. Measures that satisfy the Principle of Scale Invariance for this data set are the Coefficient of Variation, Schutz Index, Gini Coefficient, and the Variance of Logarithms because; for each of these measures, the magnitude in Column 3 equals the magnitude in Column 2 in Table 3.4. Of the thirteen equality based measures, only the Coefficient of Variation measure and the Gini Coefficient satisfy both the Principle of Transfers and the Principle of Scale Invariance. It is interesting to note that the Variance of Logarithms measure, when applied to Impact Distributions C and D, is the only measure to report that transfers from the best-off to the worst-off group will decrease fairness. A more detailed examination of the sensitivity of the equality based measures to transfers may be warranted. Most of the magnitudes of the equality measures for Impact Distributions C and D, listed in Columns 4 and 5 are different from each other, possibly implying that different measures have different transfer sensitivities, and this may prove to be another criterion for choosing an appropriate equality based fairness measure. Future investigation into the evaluation of equality based measures for alternate distribution magnitudes is recommended.

Table 3.4 Results of Applying the Measures to the Example Impact Distributions

	Equality Measure Magnitude for Impact Distribution			
Measure	**A**	**B**	**C**	**D**
Variance Measure	20.00	5.00	10.00	18.00
Coefficient of Variation	0.89	0.89	0.63	0.85
Mean Absolute Deviation Measure	8.00	4.00	6.00	8.00
Schutz Index	0.20	0.20	0.15	0.20
Variation #1 of the Mean Absolute Deviation Measure	3.00	1.50	2.00	3.00
Sum of Absolute Deviations Measure	40.00	20.00	28.00	36.00
Variation #1 of the Sum of Absolute Deviations Measure	20.00	10.00	10.00	18.00
Variation #2 of the Sum of Absolute Deviations Measure	12.00	6.00	6.00	12.00
Gini Index	0.25	0.25	0.18	0.23
Range Measure	6.00	3.00	4.00	5.00
Variation #1 of the Range Measure	6.00	3.00	4.00	5.00
Theil Entropy Coefficient	0.15	0.12	0.13	0.15
Variance of Logarithms Measure	0.05	0.05	0.45	0.12

Based on the results of this chapter, appropriate proportionality based measures are the Walster Formula and the Equal Excess Formula because these measures satisfy Impartiality, Consistency, Weighted Additive, and Fundamental Principles. The Coefficient of Variation and the Gini Coefficient are appropriate equality based fairness measures because they satisfy the Impartiality, Consistency, Weighted Additive, Transfers, and Scale Invariance Principles. Six need based measures are deemed appropriate at this point because these measures satisfy Impartiality, Consistency, and Weighted Additive Principles. As there are currently no restrictions on need based measures, potential need based measures may be all six measures presented in Table 3.1 when rewritten as to replace $\overline{A}$ with $\overline{Z}$ and $A(i)$ with $Z(i)$. These measures are variations of the Adams Formula, Walster Formula, Equal Excess Formula, Coulter Method, variation #1 of the Coulter Method, and Hoovers Concentration Index. It should be noted that more work is required to further develop principles relating to distance based fairness measures and the further evaluation of the appropriateness of these distance based measures. As more principles are developed for proportionality, equality, and need based measures, some of the appropriate measures presented here may appear inappropriate and should be rejected. Furthermore, the distance based measures found to be appropriate in this work, need to be evaluated in a more rigorous manner for other impact distributions because the measures may be inappropriate when evaluated for other impact distribution magnitudes.

Chapter 4:

INTRATEMPORAL AND INTERTEMPORAL DISTRIBUTIVE FAIRNESS MEASURES

A discussion of the sustainability issues relevant to intratemporal and intertemporal fairness considerations is presented here. Following this discussion, formulations are presented for intratemporal fairness, intertemporal fairness, and overall fairness. Using the acceptable distance measures found in Chapter 3, it is suggested that overall fairness is some weighted combination of appropriate proportionality, equality, and need based measures. Overall fairness measures are proposed here to be potential distributive fairness criteria for the purposes of sustainable project selection.

4.1 Temporal Considerations

Following the Brundtland Commission's discussion of achieving sustainability through sustainable development, the sustainability literature generally makes reference to <u>intra</u>-generational fairness and <u>inter</u>-generational fairness. <u>Intra</u>-generational fairness refers to fairness within a generation while, inter-generational fairness, considers fairness between generations. This literature raises three related questions namely, What is a generation?, Who is making the comparisons?, and What is being compared? Regarding the issue of defining a generation, the use of time steps instead of generations for such comparisons might be a more flexible approach because project related impacts are project specific and may not have a duration that exceeds a generation or may exhibit high variability within a generation. Generational comparisons would not account for this variability and in such cases an annual time step may be more appropriate than a generational time step. In this manner, the notions of intratemporal fairness and intertemporal fairness based on time steps are now introduced. Therefore, intra-generational and inter-generational fairness comparisons are simply intratemporal and intertemporal fairness comparisons when the time step equals one generation. Based on the simultaneous segments comparison approach discussed by McKerlie (1989), intratemporal comparisons are proposed here to occur across all groups during a given time step. Intertemporal comparisons are proposed here to occur, for a given group, across all time steps for which that group exists. Regarding the issue of what is being compared, it appears logical to evaluate the fairness of a project alternative based on the different impacts, where impacts may be either benefits or costs, that affect groups as a result of implementing and operating this project alternative. These impacts may originate during the construction and operational phases of a project's design life, may persist after the project has been dismantled, and may affect varying spatial scales. As the sustainability literature centers around discussions of social, economic, and ecological impacts; it is proposed that sustainable project selection be concerned with these impact types. Examples of social, economic, and ecological impacts are those that affect health and safety, a region's contribution towards the gross domestic product, and regional biodiversity, respectively.

4.2 Operational Definitions of Distributive Fairness

Consider a situation in which there are a total of I groups where group i is affected by some impact with a magnitude $E(i)$ that results from some action. In this situation, define $A(i)$ as the impact magnitude that group i feels it deserves and $Z(i)$ as the impact magnitude required to meet the needs of group i. As there are currently no restrictions on need based measures, potential need based measures may be all six measures presented in Table 3.1 when rewritten as to replace $\overline{A}$ with $\overline{Z}$ and $A(i)$ with $Z(i)$. Appropriate measures as determined in Chapter 3 are given in equations 4.1-4.10 below. These equations are based on proportionality, equality, and need comparison norms. They are:

$$P_1 = \sum_{i=1}^{I} \left| E(i) - A(i) \right| \tag{4.1}$$

$$P_2 = \left[\frac{1}{I} \sum_{i=1}^{I} \left[\frac{E(i)}{\overline{E}} - \frac{A(i)}{\overline{A}} \right]^2 \right]^{1/2} \tag{4.2}$$

$$Q_1 = \frac{\left[\sum_{i=1}^{I} \left(E(i) - \overline{E}\right)^2\right]^{1/2}}{\overline{E}} \tag{4.3}$$

$$Q_2 = \sum_{i=1}^{I} \sum_{j=1}^{I} \left[\frac{|E(i) - E(j)|}{2I^2 \overline{E}}\right] \tag{4.4}$$

$$N_1 = \sum_{i=1}^{I} |E(i) - Z(i)| \tag{4.5}$$

$$N_2 = \sum_{i=1}^{I} \sum_{j=1}^{I} \left|\frac{E(i)}{Z(i)} - \frac{E(j)}{Z(j)}\right| \tag{4.6}$$

$$N_3 = \sum_{i=1}^{I} \left|\frac{E(i) - Z(i)}{Z(i)}\right| \tag{4.7}$$

$$N_4 = \sum_{i=1}^{I} \left[\frac{E(i)}{Z(i)} - \frac{\overline{E}}{\overline{\overline{Z}}}\right]^2 \tag{4.8}$$

$$N_5 = \left[\frac{1}{I} \sum_{i=1}^{I} \left[\frac{E(i)}{\overline{E}} - \frac{Z(i)}{\overline{\overline{Z}}}\right]^2\right]^{1/2} \tag{4.9}$$

$$N_6 = \frac{1}{I} \sum_{i=1}^{I} \left[\frac{E(i)}{\overline{\overline{E}}} - \frac{Z(i)}{\overline{\overline{Z}}}\right] \tag{4.10}$$

Where: P = an appropriate proportionality based comparison approach representing deviations from a proportional impact allocation;

Q = an appropriate equality based comparison approach representing deviations from an equal impact allocation;

N = a potential need based comparison approach representing appropriate equation based on deviations from an impact allocation that satisfies the needs of all groups;

I = number of groups being considered;

i and j = group indices;

$E(i)$ = impact magnitude acting on group i

$A(i)$ = impact magnitude that group i deserves, or group i's contribution towards receiving $E(i)$;

$Z(i)$ = amount of $E(i)$ that group i requires to satisfy its needs;

$\overline{E}$ = average impact magnitude that acts upon the I groups being considered;

$\overline{Z}$ = average impact magnitude which the I groups need to meet their needs; and

$\overline{A}$ = average impact magnitude which the I groups deserve.

Equations 4.1-4.2 are appropriate proportionality based fairness measures as determined in Chapter 3 since these measures satisfy the Impartiality, Consistency, Weighted Additive, and Fundamental Principles. Equations 4.1-4.2 are commonly referred to as the Equal Excess Formula and Walster Formula. Equations 4.3-4.4 are appropriate equality based fairness measures as these measures satisfy Impartiality, Consistency, Weighted Additive, Transfers, and Scale Invariance Principles. These measures are commonly referred to as the Coefficient of Variation and the Gini Coefficient. The Gini Coefficient is commonly used by economists to measure inequality and is presented in the form given in Marsh & Schilling (1994). Two group indices, i and j, are required for equation 4.4 as the numerator of this equation is the sum of all possible pair-wise comparisons of impact magnitudes between groups. The Gini Coefficient's magnitude represents the decrease in fairness resulting from impacts that deviate from being allocated equally among all I groups. Equations 4.5-4.10 presented as need based fairness measures that may be appropriate and are the equations presented in Table 3.1 rewritten by replacing the variable that represents a group's input with a variable that represents the amount of impact that a group needs. It should be noted that other methods of operationalizing a need comparison approach, such as a binary expression of whether or not a need is met, may be possible. Equations 4.1-4.10 have values that may increase in magnitude from zero, where zero corresponds to complete fairness as defined by each comparison approach.

If equations 4.1-4.10 are to be used in the context of sustainable project selection, the equations must be expanded to address four major concerns. First, these measures are not formulated in a way that accounts for the dimensions required for intratemporal and intertemporal comparisons. Second, a project is likely to distribute many impacts among groups and a measure of fairness should account for this in some way. Third, equations 4.1-4.10 represent three different aspects of fairness evaluations and a fairness measure should incorporate all of these approaches because, for example, not all people evaluate fairness by proportionality alone and may employ one or more comparison approaches in assessing fairness. This may gain more significance when considering the extended temporal horizons associated with intertemporal fairness evaluations. Finally, as evaluations of fairness are case specific, a measure should reflect the variability in the emphasis placed on the different comparison approaches by the groups who are affected by a project.

Consider a situation in which there are X project alternatives, each distributing G different impact types to I groups over T time steps. Thus, each project alternative may be thought of as having a $G \times I \times T$ impact matrix. While it may be possible for each project impact matrix to have different magnitudes for G, I, and T, this work assumes, for simplicity, that each project alternative impact matrix is the same size. Therefore, the matrix that represents the impact magnitude accruing to group i, of impact type g, during time step t, that results from project alternative x may be written as $E(i,g,t,x)$. For each group, i, its contribution towards receiving a certain impact type, g, or the impact it deserves, may vary with time step t and is written as $A(i,g,t)$. Additionally, a group's need for a particular impact may also vary with time and is written as $Z(i,g,t)$. While equations 4.1-4.10 may all be rewritten for this generalized problem, only equations 4.1, 4.4, and 4.5 are expanded here although the remaining seven measures can be expanded in a similar manner as discussed below.

The expansion of appropriate measures into intratemporal fairness measures is accomplished for a given impact type, by applying an appropriate distance based fairness measure across all groups during a given time step. The intratemporal fairness measure magnitude may be interpreted as how fairly, according to a given norm, a given impact at a given time step is distributed among all groups. However, this results in a intratemporal fairness measure magnitude for each impact type and for each time step. The expansion of appropriate measures into intertemporal fairness measures is accomplished for a given group by applying a given appropriate measure across all time steps for which that group exists. The intertemporal fairness measure magnitude may be interpreted as how fairly, according to a given norm, a given impact for a given group is distributed over time steps. This also results in a fairness measure magnitude for each group and each impact type. The different intratemporal and intertemporal fairness measure magnitudes may be reduced to a single number by employing a mathematical operator. The mathematical operators considered here are the average, weighted average, sum, maximum, and minimum of the norm based fairness measures. Distributive fairness measure magnitudes corresponding to different impact types are suggested to be reduced to a single magnitude by employing a weighted average operator because the distributive fairness of different impacts may vary in importance. For distributive fairness measure magnitudes that correspond to different time steps, an average operator is suggested because, for a given group at a given time step, fairness at one time step should have the same weight as fairness at another time step. Distributive fairness measure magnitudes corresponding to different groups may be reduced to a single magnitude by employing an average operator is suggested here because all groups are morally equal and should have the same weight. The formulations for the intratemporal and intertemporal fairness measures based on equations 4.1, 4.4, and 4.5 are shown below as equations 4.11-4.13 and 4.14-4.16, for intratemporal and intertemporal fairness measures, respectively. It should be noted that other variations may be possible depending on the choice of the operator used with all combinations of equations 4.1-4.10.

$$B_1(x) = \frac{1}{GT}\sum_{t=1}^{T}\sum_{g=1}^{G}\left[w_g\sum_{i=1}^{I}\left|E(i,g,t,x) - A(i,g,t)\right|\right] \quad (4.11)$$

$$B_2(x) = \frac{1}{GT}\sum_{t=1}^{T}\sum_{g=1}^{G}\left[\frac{w_g\sum_{i=1}^{I}\sum_{j=1}^{I}\left|E(i,g,t,x) - E(j,g,t,x)\right|}{2I^2\overline{E_{gtx}}}\right] \quad (4.12)$$

$$B_3(x) = \frac{1}{GT}\sum_{t=1}^{T}\sum_{g=1}^{G}\left[w_g\sum_{i=1}^{I}\left|E(i,g,t,x) - Z(i,g,t)\right|\right] \quad (4.13)$$

$$B_1^{'}(x) = \frac{1}{GI}\sum_{g=1}^{G}\left[w_g\sum_{i=1}^{I}\sum_{t=1}^{T}\left|E(i,g,t,x) - A(i,g,t)\right|\right] \quad (4.14)$$

$$B_2^{'}(x) = \frac{1}{GI}\sum_{g=1}^{G}\left\{w_g\sum_{i=1}^{I}\left[\frac{\sum_{s=1}^{T}\sum_{t=1}^{T}\left|E(i,g,s,x) - E(i,g,t,x)\right|}{2T^2\overline{E_{igx}}}\right]\right\} \quad (4.15)$$

$$B_3^{'}(x) = \frac{1}{GI}\sum_{g=1}^{G}\left[w_g\sum_{i=1}^{I}\sum_{t=1}^{T}\left|E(i,g,t,x) - Z(i,g,t)\right|\right] \quad (4.16)$$

Where: $B_1(x)$ = average intratemporal fairness measure which is the weighted sum of deviations from a proportional impact allocation for all groups;

$B_2(x)$ = average intratemporal fairness measure which is the weighted sum of deviations from an equal impact allocation for all groups;

$B_3(x)$ = average intratemporal fairness measure which is the weighted sum of deviations from an allocation that meets the needs of all groups;

$B_1^{'}(x)$ = average intertemporal fairness measure which is the weighted sum of deviations from a proportional impact allocation for all groups;

$B_2^{'}(x)$ = average intertemporal fairness measure which is the weighted sum of deviations from an equal impact allocation for all groups;

$B_3^{'}(x)$ = average intertemporal fairness measure which is the weighted sum of deviations from an allocation that meets the needs of all groups;

G, I, T, X = number of different impact types, number of groups, number of time steps, and number of project alternatives, respectively;

i, g, t, x = indices for group, impact type, time step, and alternative, respectively, such that $1 \leq g \leq G$, $1 \leq i \leq I$, $1 \leq t \leq T$, and $1 \leq x \leq X$;

j, s = group and time indexes, respectively, that are required for pair-wise comparisons such that $0 \leq j \leq I$ and $1 \leq s \leq T$;

w_g = weights on impact type g, such that $\sum_{g=1}^{G} w_g = 1$;

$E(i,g,t,x)$ = magnitude of impact type g acting on group i during time step t that results from project alternative x;

$\overline{E_{gtx}}$ = average impact defined over all groups for a given a combination of impact type, time step, and alternative such that $\overline{E_{gtx}} = \frac{1}{I}\sum_{g=1}^{G} E(i,g,t,x)$;

$\overline{E_{igx}}$ = average impact defined over all time steps for a given combination of group, impact type, and alternative such that $\overline{E_{igx}} = \frac{1}{T}\sum_{t=1}^{T} E(i,g,t,x)$;

$A(i,g,t)$	=	magnitude of group i's contribution towards receiving impact type g during time t; and
$Z(i,g,t)$	=	magnitude of impact type g that meets group i's needs during time step t.

As the literature indicates that groups may evaluate fairness by more than one fair allocation norm, it is proposed here that distributive fairness measures should consist of combinations of the appropriate proportionality, equality, and need based distance measures. These appropriate distance based measures may be combined into overall measures of intratemporal and intertemporal fairness by a weighted average approach. This may be accomplished by using a normalized Cartesian based distance metrics shown below:

$$\alpha(x) = \left[\sum_{v=1}^{3} q_v^2 \left| \frac{B_v(x)}{B(x)_{**} - B(x)_*} \right|^2 \right]^{1/2} \tag{4.17}$$

$$\psi(x) = \left[\sum_{v=1}^{3} q_v^2 \left| \frac{B_v^{\cdot}(x)}{B(x)_{**}^{\cdot} - B(x)_*^{\cdot}} \right|^2 \right]^{1/2} \tag{4.18}$$

Where $\alpha(x)$	=	magnitude of average intratemporal fairness for a given project alternative x, such that $0 \le \alpha(x) \le 1$;

$\psi(x)$ = magnitude of average intertemporal fairness for a given project alternative x, such that $0 \leq \psi(x) \leq 1$;

v = index for different comparison approaches, i.e., based on different fair allocation norms;

q_v = weight attached to comparison approach v such that $\sum_{v=1}^{3} q_v = 1$;

$B(x)_v$ and $B(x)'_v$ = magnitudes of the three intratemporal and three intertemporal comparison approaches, respectively;

$B(x)_{*}$ and $B(x)'_{*}$ = minimum values of $B(x)_v$ and $B(x)'_v$ across all v given a project alternative x; and

$B(x)_{**}$ and $B(x)'_{**}$ = maximum values of $B(x)_v$ and $B(x)'_v$ across all v given a project alternative x.

Thus, distance-based measures that reflect proportionality, equality, and need fair allocation objectives are expanded to account for comparisons both within and between time steps for more than one type of impact. The expanded fairness measures are formulated in this work as averages of fairness comparisons across time steps, groups, and different impact types. In equations (4.11-4.18) weights w_g and q_v are used to represent the relative importance of fairness considerations among different project-related impacts and the relative importance placed on the three different fair allocation objectives, respectively. These weights represent the affected group's preferences and may be obtained, for example, by a social survey. According to Cohen (1978), the use of predetermined weights is a simple way of incorporating preferences into the decision making process but assumes that weights remain constant regardless of the objective functions' magnitudes and the willingness to trade-off one objective for another is independent of the magnitudes of the objective function values. This issue requires further investigation, however, it should be noted that the overall fairness measures presented in equations (4.17-4.18) may represent a social objective function of the affected groups and their views of intratemporal and intertemporal fairness, respectively.

For these measures, uncertainty in fairness measurement may arise from employing a fairness measure that relies on comparison norms that do not accurately describe the overall perception of distributive fairness for the system being managed. Uncertainty may also result from unknown values for the weights that reflect the relative importance of each type of comparison approach. Another type of uncertainty may arise due to prediction errors, e.g., errors in the predictions of the impact estimates over time. Impacts may increase, decrease, remain constant, or be some combination of these trajectories over time and the number of impacts that affect each group may increase, decrease, or remain constant over time. The uncertainty introduced by considering an increased temporal horizon may be so great that a fairness analysis may be untenable. Clearly, additional investigation of uncertainty reduction for the distributive fairness measures are needed.

Chapter 5: CASE STUDY

The North Central Electricity Supply Project case study is discussed here and the overall distributive fairness measures, presented as equations 4.11-4.18, are then applied to the estimated impacts of annual average cost per megawatt-hour of energy accruing to consumer types in different communities that results from implementing an energy supply alternative. Annual average energy cost per megawatt-hour of energy, in 1993 Canadian dollars, is hereafter referred to as the unit energy cost. The fairness of unit energy cost distributions are examined in order to discuss the applicability of the intratemporal and intertemporal fairness measures rather than the selection of a given project alternative. The results are discussed and observations about the fairness measures are given.

5.1 Background

The generalized fairness measures presented in equations 4.17-4.18 are applied in this section to a case study, known as the North Central Project, that involves selecting among two different power supply technologies for seven remote communities located in northern Canada's Boreal forest approximately 560 km northeast of Winnipeg, Manitoba. The power supply alternatives being considered to satisfy a forty-year load forecast between 1997 and 2037 are either dispersed diesel generation or a land line connection to Manitoba Hydro's central power grid. The remote communities of Oxford House, Gods Lake, Gods River, Red Sucker Lake, Garden Hill, Wasagamack, and St. Theresa Point currently have electricity supplied by diesel generators in each community. The nonremote communities of Nelson House, Cross Lake, and Split Lake are supplied by a land line connection to Manitoba Hydro's central system. These nonremote communities are used as reference communities for fairness comparisons because these communities are in the vicinity of, and have similar demographic characteristics to, the remote communities. Other communities, such as Thompson, Manitoba, may also be used as reference communities for this system but data for these communities were not available for this analysis. While Manitoba Hydro (1993) considered other power generation methods such as small scale hydro, central biomass, and dispersed biomass, these alternatives were found to be uneconomical compared to the construction of a transmission line connection to the central power grid. The proposed transmission line routing is shown in Figure 5.1.

The two energy supply alternatives are thus to continue supplying energy to the remote communities with a dispersed diesel technology or to abandon the existing technology and supply energy via a transmission line connection to the provincial electrical grid. The first alternative would require the addition of diesel generating units to each remote community over time in order to meet the forecasted peak loads. As shown in Figure 5.1, the second alternative, a transmission line originating at the Kelsey Generating Station would connect Oxford House, Gods Lake, Gods River, Red Sucker Lake, Wasagamack, Garden Hill , and St. Theresa Point to the provincial power grid.

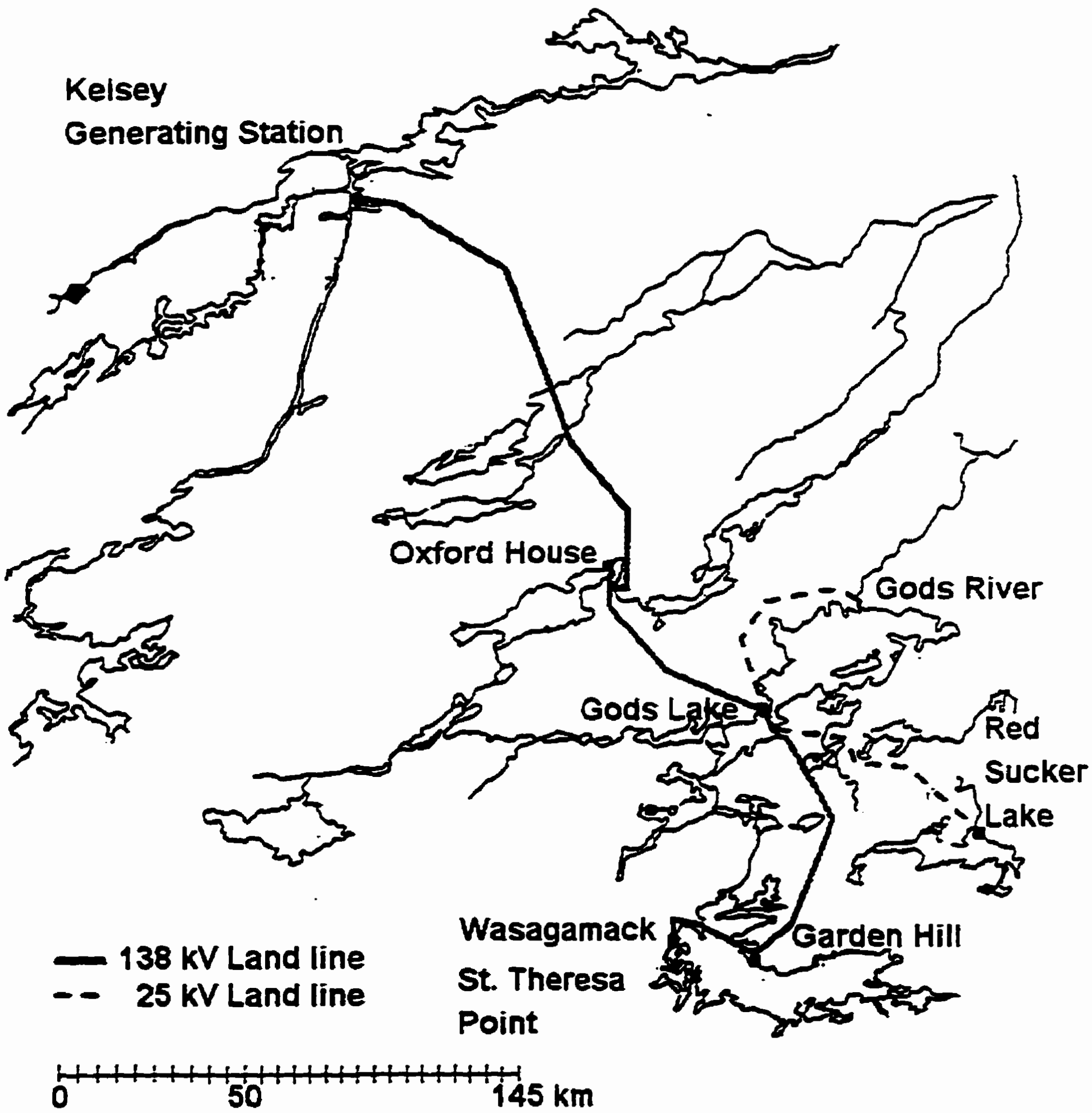

Fig. 5.1 Vicinity map of the remote communities

5.2 Generation of Annual Costs of Consumers

Within each community there are residential consumers and nonresidential consumers who pay for energy. Residential consumers consist of the people who live in each community and nonresidential consumers consist of both government and commercial facilities within the communities. Ideally, one would want to examine residential, commercial, and government consumers separately but energy demand data obtained from Manitoba Hydro (Kristjanson, 1996) were only available for residential and nonresidential aggregations. As the diesel alternative may result in a higher energy cost to consumers due to higher operating costs than the land line alternative, each alternative may be seen to result in different economic impacts among consumers. Other impacts are likely, such as particulate emissions associated with the diesel alternative, but are not considered here due to a lack of monitoring information for these facilities. An environmental impact statement for the land line alternative (Manitoba Hydro & Epstein Associates, 1993) is available but an environmental impact statement for the diesel alternative is not available. The approach taken in this work, therefore, is to examine unit energy costs accruing to a given consumer group in a given community between 1997 and 2037 which result from implementing a project alternative. This impact may be a function of Manitoba Hydro's rate charges and the energy demands of a particular consumer group in a given community.

Historical rate data (Harms, 1996) are available for a twelve year period from 1985 to 1997. These data are contained in Appendix A for Manitoba Hydro's Rate Zone 2 and Rate Zone 3 as Tables A1, A4, and A7, A10, A13, A14, respectively. A rate zone is an area where Manitoba Hydro charges uniform energy rates for energy consumed to a given type of energy consumer. For example, consumers residing in Winnipeg, a nonremote community with a central system energy supply, or a remote community with dispersed diesel supply would be charged for the energy they consume at Zone 1, 2, or 3 rates, respectively. Manitoba Hydro's energy rates, which include both a fixed cost and variable costs, are a function of the rate zone, consumer type, and energy consumed in a month.

In estimating the distribution of energy costs across consumer groups and across time, three main assumptions about the variability of consumer energy rates over time steps, the consumer energy rates that may result from implementing a project alternative, and the classification of nonresidential consumers in each community are made. Consumer energy rates for a given consumer type in a given rate zone are assumed to remain constant over time steps because rate data by which to estimate these are only available for a twelve year period of record for Rate Zone 2 and five year period of record for Rate Zone 3. These data are considered insufficient to obtain meaningful estimates of energy rate variability over the forty-year forecast period examined here. Consumer energy rates for nonremote communities are assumed to be fixed at Zone 2 energy rates regardless of the project alternative implemented because these communities are not affected by either project alternative. Remote communities currently pay Zone 3 rates because these communities currently have a power supply provided by dispersed diesel generation. If the dispersed diesel alternative is implemented, the remote communities are assumed to remain paying Zone 3 energy rates. If the land line alternative is chosen, the remote communities are assumed to pay Zone 2 rates. Energy rates distinguish among different types of energy consumers in a given rate zone but the rates for nonresidential consumer classifications in Zones 2 and 3 do not correspond. Thus, the assumption is made that nonresidential consumers in the nonremote communities are charged at small nondemand commercial Zone 2 rates. In the remote communities, the assumption is made that nonresidential consumers are charged at a weighted average of both full cost commercial and full cost government rates. Variations in weight afforded to full cost commercial and full cost government demand are listed in Table A20 given in Appendix A. The results show that weighted average remote nonresidential rates are very sensitive to the weighting used. As data on the composition of nonresidential demand were not made available by Manitoba Hydro, it was assumed that future remote nonresidential energy demands are fixed at 70 percent full cost commercial and 30 percent full cost government rates.

Monthly rate data obtained from Manitoba are used to develop annual energy cost functions as a function of residential and nonresidential consumer's energy demands when subject to Zone 2 and Zone 3 rates. Annual energy cost functions are linear and composed of a fixed annual cost and one or more variable costs. The variable costs are a function of the energy demanded by a consumer in a given year. The fixed cost and variable cost coefficients for the cost functions were obtained by taking the average of historical fixed and variable costs, converted to 1993 Canadian dollars, over the period of record. These calculations, based on a six percent discount rate, are given as Tables A1-A14 in Appendix A. As shown in Tables A15-A19, energy cost function coefficients were calculated with three different annual discount rates of 4, 6, and 8 percent and are not very sensitive to the discount rates examined. Thus, a 6 percent discount rate was used in this work. Rate Zone 2 and 3 energy cost functions for residential and nonresidential consumers are:

$$C_{res}^{Z2} = 86.90 + 72.21D_1 + 47.89D_2 \quad (5.1)$$

$$C_{nonres}^{Z2} = 223.55 + 71.581D_3 + 35.37D_4 + 41.15D_5 \quad (5.2)$$

$$C_{res}^{Z3} = 165.54 + 81.62D_6 + 48.21D_7 \quad (5.3)$$

$$C_{nonres}^{Z3} = 198.88 + 425.45D_8 \quad (5.4)$$

Where: C_{res}^{Z2} = average energy cost in 1993$ CDN for a residential consumer in Rate Zone 2;

C_{nonres}^{Z2} = average energy cost in 1993$ CDN/year for a nonresidential consumer in Rate Zone 2;

C_{res}^{Z3} = average energy cost in 1993$ CDN/year for a residential consumer in Rate Zone 3;

C_{nonres}^{Z3} = average energy cost in 1993$ CDN/year for a nonresidential consumer in Rate Zone 3;

D_1 = annual residential demand in Rate Zone 2 for the first energy block, such that $0 \leq D_1 \leq 2.1$ MWh/year;

D_2 = annual residential demand in Rate Zone 2 for the second energy block, such that $2.1 \leq D_2$ MWh/year;

D_3 = annual nonresidential demand in Rate Zone 2 for the first energy block such that $0 \leq D_3 \leq 13$ MWh/year;

D_4 = annual nonresidential demand in the second energy block in Rate Zone 2, such that $13 \leq D_4 \leq 85$ MWh/year;

D_5 = annual nonresidential demand in the third energy block in Rate Zone 2, such that $85 \leq D_5$ MWh/year;

D_6 = annual residential demand in Rate Zone 3 for the first energy block such that $0 \leq D_6 \leq 2.1$ MWh/year;

D_7 = annual residential demand in the second energy block in Rate Zone 3, such that $2.1 \leq D_7$ Mwh/year; and

D_8 = annual nonresidential demand in the first energy block in Rate Zone 3, such that $0 \leq D_8$ MWh/year.

In equations 5.1-5.4 an energy block is a portion of a consumer's annual energy demand that is charged a given rate by Manitoba Hydro. Thus, for equation 5.1, annual residential demand in Rate Zone 2, $\overline{D}$, is composed of demand blocks D_1 and D_2.

Historical demand data for residential and nonresidential consumers in remote and nonremote communities was obtained from Manitoba Hydro for a 23 year period of record from 1973 to 1996 (Kristjanson, 1996). These data, for nonremote and remote communities, are included in Appendix B as Tables B1, B4, B7, and B10, B13, B16. B19. B22, B25, B28, respectively. Two main assumptions involved in the estimation of annual energy demands are that if the land line alternative is implemented, the remote communities will exhibit a demand growth similar to that of historical nonremote community demands and, that residential demand in the nonremote communities exhibits parabolic, rather than a linear growth, in annual energy demand per meter.

Estimates of annual energy demands for residential and nonresidential consumers in the different communities over the period of 1997 to 2037 are obtained as follows. For each consumer type in each community, both annual residential demand and annual nonresidential demand per meter are calculated based on historical data available from 1973 to 1996. Scatter plots of the historical energy demand per meter are given in Appendix B in Figures B1-B6. Figures B1-B6 reveal that annual energy demands tend to increase non-monotonically in a somewhat piece-wise linear fashion. A generalized polynomial function shown as equation 5.5 that may represent annual energy demand per meter was used to find annual demand functions for residential and nonresidential consumers in the remote and nonremote communities.

$$\overline{D} = at^b + c \tag{5.5}$$

Where:	$\overline{D}$	=	annual average demand per meter for a consumer type in a given community;
	a,b,c	=	parameters specific to a consumer type and community that define the polynomial; and
	t	=	the current time step.

This was accomplished, for a given consumer type in a given community, by solving for the a, b, and c parameters in equation 5.5 such that, the sum of squared deviations between demand function values and historical values was minimized. It should be noted that better parameters may be possible as there are many varieties of possible functions. The best fit calculations using equation 5.5 to historical energy demand data are given in Appendix B for nonremote and remote communities, in Tables B2, B3, B5, B6, B8, B9, and B11, B12, B14, B15, B17, B18, B20, B21, B23, B24, B26, B27, B29, B30, respectively.

Best fit parameters determined for equation 5.5 for both consumer types in all communities are used to generate annual energy demand estimates over a forty-year period from 1997 to 2037 for each project alternative. As nonremote community energy demands are not affected by alternative selection, energy demand function parameters for Nelson House, Cross Lake, and Split Lake remain the same for both project alternatives. Annual energy demands for a given consumer type in the remote communities are expected to change if the land line alternative is implemented and thus so should the demand function parameters. As demand function parameters based on the best fit to historical data for nonremote communities have similar magnitudes to each other, the approach taken is to use the average of the nonremote communities best fit energy demand parameters over the 1973-1996 period for all remote communities for the land line alternative. This implies that for the land line alternative, the remote communities will exhibit similar demand growth between 1997 and 2037 to that of nonremote communities between 1973 and 1996. Cross Lake, Split Lake, and Nelson House were provided with a land line based energy supply between 1972-1973 (Miles, 1996). Demand function parameters for each consumer type in each community that correspond to the diesel and land line alternatives are given in Appendix B in Tables B31-B32, respectively.

For each consumer type in each community, annual energy costs in 1993 dollars that result from implementing a project alternative are estimated using equations 5.1-5.5 from 1997 to 2037, and are given in Appendix C in Tables C5-C38. On an annual basis, unit energy costs for a given consumer type in a given community, are calculated by dividing annual energy costs by annual energy demands. These unit energy costs are summarized in Tables C1-C4. Due to space limitations, the estimates of annual unit energy costs are listed in Tables 5.1 and 5.2 for residential consumers and nonresidential consumers, respectively, for the years of 1997, 2017, and 2037. There is a full listing of these data in Tables C1-C4 in Appendix C. As Table 5.1 shows, both residential and nonresidential consumers in the nonremote communities of Cross Lake, Nelson House, and Split Lake are not affected by the project alternatives. Therefore, the annual average unit energy costs for these communities in any year remain constant over all alternatives. Also shown in Table 5.1, for a given community in a given year, is a slight decrease in annual average energy costs for residential consumers in the seven remote communities when the land line alternative is implemented in 1997. This may be a result of an annual average increase in demand per residential meter after a community switches to a land line power supply since Manitoba Hydro's land line residential rate structure reflects decreasing marginal costs to the consumer. A significant decrease in annual average energy costs for nonresidential consumers under the land line alternative is shown in Table 5.2 for a given remote community in a given year. This occurs due to the decrease in nonresidential rates to the level of nonresidential rates experienced by the nonremote communities already connected to a land line based power supply.

Table 5.1 Average Energy Costs (1993$ CDN/MWh/meter) for a Residential Consumer

	Dispersed Diesel			Land Line		
Community	**1997**	**2017**	**2037**	**1997**	**2017**	**2037**
Cross Lake	52.21	51.42	50.86	52.52	51.42	50.86
Nelson House	52.55	51.43	50.87	52.55	51.43	50.87
Split Lake	51.97	50.98	50.48	51.97	50.98	50.48
Oxford House	84.22	73.43	67.62	59.19	52.07	51.06
Gods Lake	83.92	73.83	68.18	59.13	52.06	51.05
Gods River	73.39	61.95	57.65	57.23	51.77	50.88
Red Sucker Lake	74.64	63.21	58.68	57.49	51.81	50.91
Garden Hill	83.08	74.52	69.33	58.97	52.04	51.04
St. Theresa Point	81.31	71.50	66.17	58.69	52.00	51.02
Wasagamack	82.50	72.58	67.11	58.90	52.03	51.03

Table 5.2 Average Energy Costs (1993$CDN/MWh/meter) for a Nonresidential Consumer

	Dispersed Diesel			Land Line		
Community	**1997**	**2017**	**2037**	**1997**	**2017**	**2037**
Cross Lake	45.69	43.82	43.04	45.69	43.82	43.04
Nelson House	45.29	43.49	42.78	45.29	43.49	42.78
Split Lake	45.42	42.97	42.20	45.42	42.96	42.20
Oxford House	431.73	430.49	429.81	55.39	45.31	43.59
Gods Lake	434.13	433.36	432.84	61.13	45.63	43.69
Gods River	436.13	433.34	431.99	66.32	45.81	43.75
Red Sucker Lake	434.35	432.32	431.28	61.93	41.58	38.89
Garden Hill	433.99	432.48	431.43	60.88	45.61	43.69
St. Theresa Point	432.68	431.19	430.39	57.58	45.46	43.64
Wasagamack	428.61	427.86	427.48	48.81	44.48	43.28

5.3 Application of Distributive Fairness Measures and Discussion

The overall fairness measures presented in equations 4.17-4.18 are applied to this case study for an annual time step between 1997 and 2037. When considering intratemporal fairness as defined in equation 4.17, a given energy consumer evaluates fairness based on comparing unit energy costs that customers of the same type pay in the other nine communities during a given year. When considering intertemporal fairness as defined in equation 4.18, an energy consumer in a community evaluates fairness based on comparing annual unit energy costs that act on that consumer, in a given community during a given year, with the average annual energy costs for the same type of consumer in the same community over the remaining 39 years. Of the proportionality, equality, and need based comparison approaches considered in this work, the equality approach is judged to be the most applicable for both intratemporal fairness and intertemporal fairness comparisons in this case study because the quantification of each group's input and need requires further examination. Proportionality and need may be important considerations for other impact distributions associated with this case study. The approach taken here is to apply the generalized distributive fairness measures to the residential consumers and the nonresidential consumers separately. Therefore, equations 4.11-4.16 are calculated by setting I, the number of groups, equal to 10; T, the number of time steps, equal to 40; and G, the number of different impact types, equal to 1. Detailed results of the distributive fairness evaluations may be found in Appendix D. In this chapter, the $E(i,g,t,x)$ are the annual average unit energy costs in 1993$ CDN/MWh/meter and are contained in Tables 5.1 and 5.2. Equations 4.17-4.18 are then applied by using the weight of unity for q_2 and the residential and nonresidential data shown in Tables 5.1-5.2, respectively. The results of this application are shown in Table 5.3 and are also given in detail in Appendix D as Tables D1-D9. The intratemporal fairness measure, $\alpha(x)$, indicates that fairness may increase, regarding the distribution of unit energy costs for both the residential and nonresidential consumers, if the land line alternative is selected because the average annual unit energy costs will be more equal to that experienced by the nonremote communities if the land line alternative is selected. The intertemporal fairness measure, $\psi(x)$, does not indicate a difference among project alternatives as the average annual unit energy costs, for a given consumer group, remain fairly constant over time. The greatest intratemporal fairness increase associated with switching from dispersed diesel supply to a land line supply would be experienced by nonresidential consumers who appear worse-off under the existing dispersed diesel energy supply. This can be seen in Table 5.3 by comparing the fairness measure magnitudes of 0.26 and 0.02 for the dispersed diesel and land line alternatives, respectively. Of course, other types of impacts, such as impacts to health and safety may show a greater difference between alternatives for fairness considerations. The analysis of average annual energy costs per megawatt-hour is only one of a number of different impacts associated with each project alternative and thus represents a partial perspective of the perceived fairness present in this system. As data on these and other impacts such as environmental changes and reliability of power supply become available, for each alternative, further comparisons should be made before the analyst could advise the decision maker.

Table 5.3: Intratemporal and Intertemporal Fairness Measure Magnitudes

	$\alpha(x)$ Intratemporal Fairness Measure		$\psi(x)$ Intertemporal Fairness Measure	
Alternative	Residential	Non residential	Residential	Non residential
Dispersed diesel	0.08	0.26	0.01	0.01
Land line	0.01	0.02	0.01	0.01

Chapter 6:

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.1 Summary and Conclusions

Sustainable development, project selection, fair allocation objectives, empirical distance based fairness measures and their evaluation, and the application of these measures to real problems, are reviewed in this work. While distance based fairness measures have been applied in the literature, a consensus as to the appropriate measures and principles associated with these measures was not found. The norm based and normative approaches are two broad approaches to distance based fairness measurement. While the norm based approach appears to be the easiest to apply in conjunction with distance based measures, this approach is not yet fully developed.

Based on proportionality, equality, and need fair allocation norms, Chapter 3 of this work classifies twenty commonly applied distance based fairness measures as either potential proportionality, equality, and need based fairness measures. A number of principles found in the literature are discussed and then categorized as principles associated with either fairness, proportionality, equality, or need based fair allocation norms. Principles associated with fairness are Impartiality, Consistency, and Weighted Additive Principles. The Fundamental Principle is associated with a proportionality norm. The Transfers and Scale Invariance Principles are associated with an equality norm. As no measures of need nor principles associated with need are given in the literature, variations of proportionality based fairness measures are suggested as initial need based fairness measures. The potential measures are then evaluated with respect to how well each measure satisfies the fairness principles and the principles associated with the norm which that measure embodies. Appropriate proportionality based measures are Wasters Formula and the Equal Excess Formula because these measures satisfy the Impartiality, Consistency, Weighted Additive, and Fundamental Principles. The Relative Mean Deviation Measure and the Gini Coefficient are appropriate equality based measures because these measures satisfy the Impartiality, Consistency, Weighted Additive, Transfers, and Scale Invariance Principles. Six potential need based measures are proposed at this point because these measures satisfy the Impartiality, Consistency, and Weighted Additive Principles. These potential need based measures, which are variations of common proportionality based measures such as Walsters and Adams Formulae, must be further evaluated as additional evaluation criteria become available. These appropriate distance based fairness measures are recommended for expansion to be compatible with sustainable project selection.

Fairness considerations in sustainable project selection requires measures that incorporate intratemporal and intertemporal comparisons and have an ability to be applied in a project selection context for multiple impacts which affect multiple groups of similarly situated individuals. Additionally, distributive fairness measures should incorporate more than one fair allocation norm, such as equality, as the literature indicates that people judge the fairness of a distributive situation by one or more of the fair allocation norms. The norm based measures are extended to address a generic situation for intratemporal comparisons, intertemporal comparisons, and multiple impact types. These extended norm based fairness measures are then combined into overall intratemporal and overall intertemporal fairness measures at the end of Chapter 4 in this work. These overall fairness measures incorporate three common perceptions of fair allocation by employing a weighted average of the extended proportionality, equality, and needs based fairness measures. These overall fairness measures may be a more flexible approach to measuring distributive fairness in different cases and over long time horizons. It should be mentioned that the overall fairness measures developed in this work are a mathematical abstraction of a social system and should not be considered as being precise measures of fairness. The overall fairness measures may serve as a starting point from which more refined fairness measures for sustainable project selection may be developed. Uncertainty may be introduced from a number of sources, for example, in employing fairness measures that rely on comparison norms that do not accurately describe the overall perception of distributive fairness for the system being managed. Uncertainty reduction in distributive fairness measurement is seen as an important issue that must be addressed in future work. The overall distributive fairness measures presented in this work are, to this author's knowledge, an original contribution to the topic of sustainable project selection. The overall distributive measures may also be interpreted as intratemporal and intertemporal social objective functions that are defined by the weights employed with each measure. Additionally, the formulation of these measures may serve to guide data collection efforts for the purposes of fairness evaluation for sustainable project selection.

In Chapter 5, the overall distributive fairness measures are applied to a case study that requires the analyst to choose between either a dispersed diesel generation or land line based connection to a central power grid in order to meet energy demands over a forty-year horizon. The fairness measures are applied to annual average energy costs per megawatt-hour, or unit energy costs, accruing to residential and nonresidential energy consumers in ten communities as a result of implementing a project alternative. The distributive fairness criteria formulated for this case study are based on an equality comparison approach. As more work is required for further development of proportionality and need based fairness measures, the application of these measures to this case study was not accomplished. Intratemporal fairness concerning the distribution of average annual unit energy costs, particularly for the nonresidential energy consumers, may be increased by choosing the land line alternative. While other approaches to defining a fair allocation and other interpretations of fairness are possible, the measures presented here provide conclusions that are reasonable and they may offer a greater insight into fairness evaluations for sustainable project selection. The distributive fairness measures presented in this work are considered to be useful as criteria for sustainable project selection and may also be useful for other applications in civil engineering. For example, the distributive fairness measures might be modified and used to develop reservoir operating strategies that distribute reservoir related impacts in some fair manner. The main limitation in applying this approach is seen to be the estimation of the impact distributions that result from each project alternative and the weights that indicate the avaerage of affected group's preferences. Impact assessment and impact valuation, particularly for impacts over long time horizons are daunting tasks and remain to be addressed. Civil engineering projects, particularly the provision of public services may affect a large number of people, thus fairness considerations may be important to the analyst who advises the decision maker.

6.2 Recommendations

Further investigation into other fairness measurement approaches for sustainable project selection, a further refinement of the fairness measures presented here, investigation of the effects and accommodation of uncertainty, and the further examination of this and other case studies are recommended. Research efforts could be directed at investigating the relevance of proportionality and need allocation approaches in project selection and identifying the factors that influence the relative importance placed on different comparison approaches by groups. Additional desirable principles associated with intratemporal and intertemporal measures of proportionality, equality, and need may exist and this issue should be investigated in more detail. Much work remains in defining and measuring needs. The appropriate norm based measures should also be evaluated for different impact distribution magnitudes as these measures may be inappropriate. Further research may be directed at the interpretation of the overall distributive fairness measures. Moreover, efforts toward reducing associated measurement, weighting, and impact prediction uncertainties need to be undertaken and ultimately these approaches for measuring fairness need to be validated.

References:

Aberly, D. (Ed.), *Futures by Design: The Practice of Ecological Planning*, New Society Publishers, Gabriola Island, Canada, 1994.

Adams, J., Toward and understanding of inequity, *Journal of Abnormal and Social Psychology*, *67*(5), 422-436, 1963.

Alker, H. and B. Russett, On measuring inequality, *Behavioral Science*, *9*, 207-218, 1964.

Allison, P., Measures of inequality, *American Sociological Review*, *43*, 865-880, 1978.

Almond, B., Rights and justice in the environment debate, Appears in *Just Environments: Intergenerational, International, and Interspecies issues*, eds. D. Cooper & J. Palmer, Routledge, New York, USA, 1995.

Arthur, J. & W. Shaw, *Justice and Economic Distribution*, Prentice-Hall Inc., New Jersey, USA, 1978.

Atkinson, A., On the measurement of inequality, *Journal of Economic Theory*, *2*, 244-263, 1970.

Beltratti, A., Intergenerational equity and environmental preservation. *Energy, Environment, and Economic Growth, 42.95*. University of Torino and Fondazione, Milan, Italy, 1995.

Blalock, H., *Understanding Social Inequality: Modeling Allocation Processes*, Sage Publications, London, UK, 1991.

Bogardi, J. and H. Nachtnebel (eds), *Multicriteria Decision Analysis in Water Resources Management*, UNESCO, Paris, France, 1994.

Brill, E., *Economic Efficiency and Equity in Water Quality Management*, Phd. Dissertation, The Johns Hopkins University, Baltimore, Maryland, USA, 1972.

Champernowne, D., A comparison of measures of inequality of income distribution, *The Economic Journal, 84*, 787-816, 1974.

Cohen, J., *Multiobjective Programming and Planning*, Academic Press, New York, USA. 1978.

Cook, K. & T. Yamagishi, Social determinants of equity judgments: the problem of multidimensional input, Appears in *Equity Theory*, Eds. D. Messick & K. Cook, Praeger Publishers, New York, USA, 95-125, 1983.

Dalton, H., The measurement of the inequality of incomes, *The Economic Journal, 30*, 348-361, 1920.

Deutsch, M., Equity, equality, and need: What determines which value will be used as the basis of distributive justice, *Journal of Social Issues, 31* (3), 137-149, 1975.

Dovers, S. & J. Handmer, Contradictions in sustainability, *Environmental Conservation*, 20(3), 217-222, 1993.

Erickson, P., *A Practical Guide To Environmental Impact Assessment*, Academic Press, Boston, USA, 1994.

Erkut, E., *Inequality Measures for Location Problems*, Research Report *91-2* for the Department of Finance and Management Science, University of Alberta, Edmonton, Canada, 1992.

Harms, L., Personal communication, Manitoba Hydro, Winnipeg, Canada, 1996.

Harris, R., Pinning down the equity formula, Appears in *Equity Theory*, Eds. by D. Messick & K. Cook, 207-241, Prager Publishers, New York, USA, 1983.

Holdren, J., C. Gretchen, C. Daily, & P. Ehrlich, The meaning of sustainability: biogeophysical aspects, Appears in *Defining and Measuring Sustainability: The Biogeophysical Foundations*, Eds. M. Munasinghe & W. Shearer, The United Nations and the World Bank, Washington, USA, 3-17, 1995.

Kolm, S., Unequal inequalities I, *Journal of Economic Theory*, *12*, 416-442, 1976.

Kristjanson, R., Personal communication, Manitoba Hydro, Winnipeg, Canada, 1996.

Lele, S., Sustainable development: A critical review, *World Development*, *19*(6), 607-621, 1991.

McAllister, D., Equity and efficiency in public facility location, *Geographical Analysis*, *8*, 47-63, 1976.

McKerlie, D., Equality and time, *Ethics*, *99*, 475-491, 1989.

Mandell, M., Modeling effectiveness-equity tradeoffs in public service delivery systems, *Management Science*, *37*(4), 467-482, 1991.

Manitoba Hydro Corporation, *Review of North Central Options*, A Generation Planning Technical Memorandum, *93/7*, Winnipeg, Canada, 1993.

Manitoba Hydro Corporation & Epstein Associates Inc., *North Central Project Route/Site Selection and Environmental Assessment, 1-4*, Winnipeg, Canada, 1993.

Marsh, M. & D. Schilling, Equity measurement in facility location analysis: A review and framework, *European Journal of Operational Research*, *74*, 1-17, 1994.

Matheson, S., B. Lence, and J. Fürst, Distributive fairness considerations in sustainable project selection, Submitted to the *Hydrologic Sciences Journal*, 1997.

Mayhew, L. & G. Leonardi, Equity, efficiency, and accessibility in urban and regional health care systems, *Environment and Planning A*, *14*, 1479-1507, 1982.

Messick, D. & K. Cook (Eds.), *Equity Theory*, Praeger Publishers, New York, USA, 1983.

Miles, A., Personal communication, Manitoba Hydro, Winnipeg, Canada, 1996.

Mill, J. (1861) Utilitarianism, *In Utilitarianism and Other Essays*, ed. A. Ryan, Penguin Press, London, UK, 1987.

Morita, T, Y. Kawahima, & I. Inohara, Sustainable development - Its definitions and goals, *Mita Journal of Economics*, *85*(4), 1993.

Mulligan, G., Equality measures and facility location. *Papers in Regional Science: The Journal of The Regional Science Association International*, *70*(4), 345-365, 1991.

Munasinghe, M. & J. McNeely, Key concepts and terminology of sustainable development, Appears in *Defining and Measuring Sustainability: The Biogeophysical Foundations*. Eds. M. Munasinghe & W. Shearer, The United Nations and the World Bank, Washington, USA, 19-56, 1995.

Munasinghe, M. & W. Shearer (Eds.), *Defining and Measuring Sustainability: The Biogeophysical Foundations*, The United Nations and The World Bank: Washington, USA, 1995.

Nachtnebel, H., G. Eder, & I. Bogardi, Evaluation of criteria in hydropower utilization in the context of sustainable development. In *Proceedings of the International UNESCO Symposium: Water Resources Planning in a Changing World*, Karlsruhe, Germany, 13-24, 1994.

Nozick, R., *Anarchy, State, and Utopia*, Basic Books, New York, USA, 1974.

Pigou, A.C., *Wealth and Welfare*, MacMillan Press, London, UK, 1912.

Rawls, J., *A Theory of Justice*, Harvard University Press, Cambridge, UK, 1971.

Sampath, R., A rawlsian evaluation of irrigation distribution in India, *Water Resources Bulletin*, *27*, 745-751, 1991.

Savas, E., On equity in providing public services, *Management Science*, *24*(8), 800-808, 1978.

Simonovic, S., B. Lence, & D. Burn, Sustainability criteria: An application to the hydropower industry, *Proceedings of the ASCE 22nd Annual Conference of Water Resources Planning and Management-Integrated Water Resources Planning for the 21st Century*, ed. M. Domenica, 173-176, 1995.

Temkin, L., *Inequality*, Oxford University Press, New York, USA, 1993.

Thomson, J., trans., *The Ethics of Aristotle: Nicomachean Ethics*, Harmondsworth, Middlesex, Penguin Books, UK, 1985.

United Nations Department of Technical Co-operation for Development, *Assessment of Multiple Objective Water Resource Projects: Approaches for Developing Countries*, United Nations Press, New York, USA, 1988.

World Commission on Environment and Development (WCED), *Our Common Future*, Oxford University Press, London, UK, 1987.

Young, H., *Equity: In Theory and Practice*, Princeton University Press, New Jersey, USA, 1994.

Young, M., *Sustainable Investment and Resource Use: Equity, Environmental Integrity, and Economic Efficiency*, Man and the Biosphere Series, *9*, The Parthenon Publishing Group Inc., New Jersey, USA, 1992.

Appendix A:

Rate Calculations

Table A1: *Monthly historical rates for zone 2 (residential consumers)*

Year	Basic Charge < 200 A ($CDN/Month)	Basic Charge > 200 A ($CDN/Month)	Underground Charge ($CDN/Month)	Energy Charge First Block (Cents/KWh)	First Block (KWh/Month)	Energy Charge Balance (Cents/KWh)
1985	5.01	8.93	2.61	5.587	175	3.175
1986	5.18	9.23	2.68	5.769	170	3.278
1987	5.61	10.08	2.93	6.090	170	3.653
1988	5.89	10.57	3.06	6.171	175	3.836
1989	6.22	11.17	3.24	6.362	175	4.078
1990	6.48	11.68	3.24	6.539	175	4.306
1991	6.69	12.06	2.15	6.501	175	4.473
1992	6.86	12.40	1.20	6.587	175	4.639
1993	6.86	12.40	1.20	6.587	175	4.639
1994	7.02	12.69	0.60	6.615	175	4.746
1995	7.19	13.00	0.00	6.530	175	4.853
1996	7.43	13.48	0.00	6.530	175	5.020
1997	7.63	13.68	0.00	6.530	175	5.160

Table A2: Annual historical rates for zone 2 (residential consumers)

Year	Basic Charge < 200 A ($CDN/Year)	Basic Charge > 200 A ($CDN/Year)	Underground Charge ($/Year)	Energy Charge First Block ($CDN/MWh)	First Block (MWh/Year)	Energy Charge Balance ($CDN/MWh)
1985	60.12	107.16	31.32	55.87	2.100	31.75
1986	62.16	110.76	32.16	57.69	2.040	32.78
1987	67.32	120.96	35.16	60.90	2.040	36.53
1988	70.68	126.84	36.72	61.71	2.100	38.36
1989	74.64	134.04	38.88	63.62	2.100	40.78
1990	77.76	140.16	38.88	65.39	2.100	43.06
1991	80.28	144.72	25.80	65.01	2.100	44.73
1992	82.32	148.80	14.40	65.87	2.100	46.39
1993	82.32	148.80	14.40	65.87	2.100	46.39
1994	84.24	152.28	7.20	66.15	2.100	47.46
1995	86.28	156.00	0.00	65.30	2.100	48.53
1996	89.16	161.76	0.00	65.30	2.100	50.20
1997	91.56	164.16	0.00	65.30	2.100	51.60

Table A3: Annual historical rates in 1993 $CDN for zone 2 (residential consumers)

ANNUAL DISCOUNT RATE: 6.00 %

Year	Periods From 1993	Basic Charge < 200 A (1993 $CDN/Year)	Underground Charge (1993 $CDN/Year)	Energy Charge First Block (1993 $CDN/MWh)	First Block (MWh/Year)	Energy Charge Balance (1993 $CDN/MWh)
1985	8	95.82	49.92	89.05	2.100	50.60
1986	7	93.47	48.36	86.74	2.040	49.29
1987	6	95.49	49.88	86.39	2.040	51.82
1988	5	94.59	49.14	82.58	2.100	51.33
1989	4	94.23	49.09	80.32	2.100	51.48
1990	3	92.61	46.31	77.88	2.100	51.29
1991	2	90.20	28.99	73.05	2.100	50.26
1992	1	87.26	15.26	69.82	2.100	49.17
1993	N/A	82.32	14.40	65.87	2.100	46.39
1994	1	79.47	6.79	62.41	2.100	44.77
1995	2	76.79	0.00	58.12	2.100	43.19
1996	3	74.86	0.00	54.83	2.100	42.15
1997	4	72.52	0.00	51.72	2.100	40.87
AVERAGE		86.90	27.55	72.21	2.09	47.89

Table A4: Monthly historical rates for zone 2 (small nondemand consumers)

Year	Basic Charge ($CDN/Month)	Three Phase Charge ($CDN/Month)	Energy Charge First Block (Cents/KWh)	First Block (KWh/Month)	Energy Charge Second Block (Cents/KWh)	Second Block (KWh/Month)	Energy Charge Balance (Cents/KWh)
1985	11.62	0.00	5.91	1100.00	0.00	0.00	3.67
1986	12.01	0.00	5.99	1090.00	0.00	0.00	3.77
1987	12.95	0.00	6.34	1090.00	0.00	0.00	4.15
1988	13.45	1.00	6.55	1090.00	0.00	0.00	4.34
1989	13.70	2.62	6.50	1090.00	4.43	11700.00	3.20
1990	14.33	2.66	6.39	1090.00	4.68	10000.00	3.20
1991	14.99	2.79	6.39	1090.00	4.92	10000.00	3.28
1992	15.47	2.88	6.34	1090.00	5.11	10000.00	3.33
1993	15.47	2.88	6.34	1090.00	5.11	10000.00	3.33
1994	15.73	2.94	6.30	1090.00	5.26	10000.00	3.37
1995	15.97	3.00	5.25	1090.00	5.40	10000.00	3.41
1996	16.07	4.42	6.25	1090.00	5.48	10000.00	3.47
1997	16.23	5.96	6.25	1090.00	5.55	10000.00	3.52

Table A5: Annual historical rates for zone 2 (small nondemand consumers)

Year	Basic Charge ($CDN/Year)	Three Phase Charge ($CDN/Year)	Energy Charge First Block ($CDN/MWh)	First Block (MWh/Year)	Energy Charge Second Block ($CDN/MWh)	Second Block (MWh/Year)	Energy Charge Balance ($CDN/MWh)
1985	139.44	0.00	59.05	13.20	0.00	0.00	36.66
1986	144.12	0.00	59.92	13.08	0.00	0.00	37.70
1987	155.40	0.00	63.35	13.08	0.00	0.00	41.45
1988	161.40	12.00	65.48	13.08	0.00	0.00	43.36
1989	164.40	31.44	65.00	13.08	44.34	140.40	32.00
1990	171.96	31.92	63.93	13.08	46.75	120.00	32.00
1991	179.88	33.48	63.93	13.08	49.23	120.00	32.77
1992	185.64	34.56	63.42	13.08	51.10	120.00	33.26
1993	185.64	34.56	63.42	13.08	51.10	120.00	33.26
1994	188.76	35.28	63.02	13.08	52.57	120.00	33.71
1995	191.64	36.00	52.51	13.08	53.99	120.00	34.11
1996	192.84	53.04	62.50	13.08	54.80	120.00	34.70
1997	194.76	71.52	62.50	13.08	55.50	120.00	35.20

Table A6: Annual historical rates for zone 2 (small nondemand consumers)

ANNUAL DISCOUNT RATE: 6.00 %

Year	Periods From 1993	Basic Charge (1993 $CDN/Year)	Three Phase Charge (1993 $CDN/Year)	Energy Charge First Block (1993 $CDN/MWh)	First Block (MWh/Year)	Energy Charge Second Block (1993 $CDN/MWh)	Second Block (MWh/Year)	Energy Charge Balance (1993 $CDN/MWh)
1985	8	222.25	0.00	94.12	13.20	0.00	0.00	58.43
1986	7	216.70	0.00	90.10	13.08	0.00	0.00	56.69
1987	6	220.44	0.00	89.86	13.08	0.00	0.00	58.80
1988	5	215.99	16.06	87.63	13.08	0.00	0.00	58.03
1989	4	207.55	39.69	82.06	13.08	55.98	140.40	40.40
1990	3	204.81	38.02	76.14	13.08	55.68	120.00	38.11
1991	2	202.11	37.62	71.83	13.08	55.31	120.00	36.82
1992	1	196.78	36.63	67.23	13.08	54.17	120.00	35.26
1993	N/A	185.64	34.56	63.42	13.08	51.10	120.00	33.26
1994	1	178.08	33.28	59.45	13.08	49.59	120.00	31.80
1995	2	170.56	32.04	46.73	13.08	48.05	120.00	30.36
1996	3	161.91	44.53	52.48	13.08	46.01	120.00	29.13
1997	4	154.27	56.65	49.51	13.08	43.96	120.00	27.88
AVERAGE		195.16	28.39	71.58	13.09	35.37	84.65	41.15

Table A7: Monthly historical rates for zone 3 (residential consumers)

Year	Basic Charge < 200 A ($CDN/Month)	Basic Charge > 200 A ($CDN/Month)	Energy Charge First Block (Cents/KWh)	First Block (KWh/Month)	Energy Charge Balance (Cents/KWh)
1985	9.79	13.71	6.40	215.00	3.18
1986	9.99	14.04	6.60	205.00	3.28
1987	11.08	15.55	6.92	185.00	3.65
1988	11.66	16.34	7.09	175.00	3.84
1989	12.12	17.07	7.17	175.00	4.08
1990	12.38	17.58	7.35	175.00	4.31
1991	12.78	18.15	7.31	175.00	4.47
1992	12.99	18.53	7.37	175.00	4.64
1993	12.99	18.53	7.37	175.00	4.64
1994	13.10	18.77	7.40	175.00	4.75
1995	13.21	19.02	7.33	175.00	4.85
1996	13.45	19.50	7.33	175.00	5.50
1997	13.65	19.90	7.33	175.00	5.16

Table A8: Annual historical rates for zone 3 (residential consumers)

Year	Basic Charge < 200 A ($CDN/Year)	Basic Charge > 200 A ($CDN/Year)	Energy Charge First Block ($CDN/MWh)	First Block (MWh/Year)	Energy Charge Balance ($CDN/MWh)
1985	117.48	164.52	64.00	2.58	31.75
1986	119.88	168.48	66.02	2.46	32.78
1987	132.96	186.60	69.23	2.22	36.53
1988	139.92	196.08	70.92	2.10	38.36
1989	145.44	204.84	71.74	2.10	40.78
1990	148.56	210.96	73.51	2.10	43.06
1991	153.36	217.80	73.14	2.10	44.73
1992	155.88	222.36	73.65	2.10	46.39
1993	155.88	222.36	73.65	2.10	46.39
1994	157.20	225.24	74.00	2.10	47.46
1995	158.52	228.24	73.30	2.10	48.53
1996	161.40	234.00	73.30	2.10	55.02
1997	163.80	238.80	73.30	2.10	51.60

Table A9: Annual rates in1993$ for zone 3 (residential consumers)

Annual discount rate: 6.00 %

Year	Periods From 1993	Basic Charge < 200 A (1993 $CDN/Year)	Energy Charge First Block (1993 $CDN/MWh)	First Block (MWh/Year)	Energy Charge Balance (1993 $CDN/MWh)
1985	8	187.25	102.01	2.58	50.60
1986	7	180.26	99.27	2.46	49.29
1987	6	188.61	98.20	2.22	51.82
1988	5	187.24	94.91	2.10	51.33
1989	4	183.61	90.57	2.10	51.48
1990	3	176.94	87.55	2.10	51.29
1991	2	172.32	82.18	2.10	50.26
1992	1	165.23	78.07	2.10	49.17
1993	0	155.88	73.65	2.10	46.39
1994	1	148.30	69.81	2.10	44.77
1995	2	141.08	65.24	2.10	43.19
1996	3	135.51	61.54	2.10	46.20
1997	4	129.74	58.06	2.10	40.87
AVERAGE		165.54	81.62	2.17	48.21

Table A10: Monthly historical rates for zone 3 (general service consumers)

Year	Basic Charge ($CDN/Month)	Three Phase Charge ($CDN/Month)	Energy Charge First Block (Cents/KWh)	First Block (KWh/Month)	Energy Charge Second Block (Cents/KWh)	Second Block (KWh/Month)	Energy Charge Balance (Cents/KWh)
1985	13.57	0.00	6.03	1100.00	0.00	0.00	3.67
1986	13.99	0.00	6.12	1090.00	0.00	0.00	3.77
1987	15.01	0.00	6.45	1090.00	0.00	0.00	4.15
1988	15.51	1.00	6.67	1090.00	0.00	0.00	4.34
1989	15.76	2.62	6.62	1090.00	4.43	11700.00	3.20
1990	16.45	2.66	6.51	1090.00	4.68	10000.00	3.20
1991	17.22	2.79	6.51	1090.00	4.92	10000.00	3.28
1992	17.77	2.88	6.46	1090.00	5.11	10000.00	3.33
1993	17.77	2.88	6.46	1090.00	5.11	10000.00	3.33
1994	18.05	2.94	6.42	1090.00	5.26	10000.00	3.37
1995	18.30	3.00	6.37	1090.00	5.40	10000.00	3.41
1996	18.40	4.42	6.36	1090.00	5.48	10000.00	3.47
1997	18.56	5.96	6.36	1090.00	5.55	10000.00	3.52

Table A11: Annual historical rates for zone 3 (general service consumers)

Year	Basic Charge ($CDN/Year)	Three Phase Charge ($CDN/Year)	Energy Charge First Block ($CDN/MWh)	First Block (MWh/Year)	Energy Charge Second Block ($CDN/MWh)	Second Block (MWh/YEAR)	Energy Charge Balance ($CDN/MWh)
1985	162.84	0.00	60.29	13.20	0.00	0.00	36.66
1986	167.88	0.00	61.20	13.08	0.00	0.00	37.70
1987	180.12	0.00	64.54	13.08	0.00	0.00	41.45
1988	186.12	12.00	66.67	13.08	0.00	0.00	43.36
1989	189.12	31.44	66.19	13.08	44.34	140.40	32.00
1990	197.40	31.92	65.12	13.08	46.75	120.00	32.00
1991	206.64	33.48	65.12	13.08	49.23	120.00	32.77
1992	213.24	34.56	64.60	13.08	51.10	120.00	33.26
1993	213.24	34.56	64.60	13.08	51.10	120.00	33.26
1994	216.60	35.28	64.20	13.08	52.57	120.00	33.71
1995	219.60	36.00	63.69	13.08	53.99	120.00	34.11
1996	220.80	53.04	63.60	13.08	54.80	120.00	34.70
1997	222.72	71.52	63.60	13.08	55.50	120.00	35.20

Table A12: Annual historical rates for zone 3 in 1993$ (general service consumers)

ANNUAL DISCOUNT RATE: 6.00 %

Year	Periods From 1993	Basic Charge (1993 $CDN/Year)	Three Phase Charge (1993 $CDN/Year)	Energy Charge First Block (1993 $CDN/MWh)	First Block (MWh/Year)	Energy Charge Second Block (1993 $CDN/MWh)	Second Block (MWh/Year)	Energy Charge Balance (1993 $CDN/MWh)
1985	8	259.54	0.00	96.09	13.20	0.00	0.00	58.43
1986	7	252.43	0.00	92.02	13.08	0.00	0.00	56.69
1987	6	255.50	0.00	91.55	13.08	0.00	0.00	58.80
1988	5	249.07	16.06	89.22	13.08	0.00	0.00	58.03
1989	4	238.76	39.69	83.56	13.08	55.98	140.40	40.40
1990	3	235.11	38.02	77.56	13.08	55.68	120.00	38.11
1991	2	232.18	37.62	73.17	13.08	55.31	120.00	36.82
1992	1	226.03	36.63	68.48	13.08	54.17	120.00	35.26
1993	0	213.24	34.56	64.60	13.08	51.10	120.00	33.26
1994	1	204.34	33.28	60.57	13.08	49.59	120.00	31.80
1995	2	195.44	32.04	56.68	13.08	48.05	120.00	30.36
1996	3	185.39	44.53	53.40	13.08	46.01	120.00	29.13
1997	4	176.42	56.65	50.38	13.08	43.96	120.00	27.88
AVERAGE		224.88	28.39	73.64	13.09	35.37	84.65	41.15

Table A13: Historical rates for zone 3 (diesel full cost commercial consumers)

ANNUAL DISCOUNT RATE: 6.00 %

Year	Periods From 1993	Basic Charge ($CDN/Month)	Basic Charge ($CDN/Year)	Basic Charge (1993 $CDN/Year)	Energy Charge per KWh (Cents/KWh)	Energy Charge per MWh ($CDN/MWh)	Energy Charge per MWh (1993 $CDN/MWh)
1992	1	17.91	214.92	227.82	32.40	324.00	343.44
1993	0	17.91	214.92	214.92	32.40	324.00	324.00
1994	1	18.05	216.60	204.34	33.10	331.00	312.26
1995	2	18.05	216.60	192.77	33.10	331.00	294.59
1996	3	18.05	216.60	181.86	33.10	331.00	277.91
1997	4	18.05	216.60	171.57	33.10	331.00	262.18
AVERAGE		18.00	216.04	198.88	32.87	328.67	302.40

Table A14: Historical rates for zone 3 (full cost government consumers)

ANNUAL DISCOUNT RATE: 6.00 %

Year	Periods From 1993	Basic Charge ($CDN/Month)	Basic Charge ($CDN/Year)	Basic Charge (1993 $CDN/Year)	Energy Charge per KWh (Cents/KWh)	Energy Charge per MWh ($CDN/MWh)	Energy Charge per MWh (1993 $CDN/MWh)
1992	1	17.91	214.92	227.82	70.20	702.00	744.12
1993	0	17.91	214.92	214.92	83.20	832.00	832.00
1994	1	18.05	216.60	204.34	77.90	779.00	734.91
1995	2	18.05	216.60	192.77	77.90	779.00	693.31
1996	3	18.05	216.60	181.86	77.90	779.00	654.06
1997	4	18.05	216.60	171.57	77.90	779.00	617.04
AVERAGE		18.00	216.04	198.88	77.50	775.00	712.57

Table A15: Average rate for zone 2 (residential consumers)

Parameter	4%	6%	8%
Fixed Annual Cost (1993 $CDN)	83.32	86.90	90.99
D_1 (1993 $CDN/MWh)	68.85	72.21	76.03
D_2 (1993 $CDN/MWh)	45.99	47.89	50.08

Table A16: Average rate for zone 2 (small nondemand consumers)

Parameter	4%	6%	8%
Fixed Annual Cost (1993 $CDN)	215.27	223.55	233.08
D_3 (1993 $CDN/MWh)	68.01	71.58	75.62
D_4 (1993 $CDN/MWh)	35.27	35.37	35.55
D_5 (1993 $CDN/MWh)	38.97	41.15	43.62

Table A17: Average rate for zone 3 (residential consumers)

Parameter	4%	6%	8%
Fixed Annual Cost (1993 $CDN)	158.41	165.54	173.66
D_6 (1993 $CDN/MWh)	77.77	81.62	85.98
D_7 (1993 $CDN/MWh)	46.32	48.21	50.37

Table A18: Average rate for zone 3 (full cost commercial consumers)

Parameter	4%	6%	8%
Fixed Annual Cost	204.11	198.88	194.07
Variable Annual Cost Coefficient	310.41	302.40	295.04

Table A19: Average rate for zone 3 (full cost government consumers)

Parameter	4%	6%	8%
Fixed Annual Cost	204.11	198.88	194.07
Variable Annual Cost Coefficient	731.63	712.57	695.05

Table A20: Average rates for zone 3 (nonresidential consumers)

Commercial Demand (%)	0	20	40	60	70	80	100
Government Demand (%)	100	80	60	40	30	20	0
D_8 (1993 $CDN/MWh)	712.57	630.54	548.50	466.47	425.45	384.43	302.40

Appendix B:

Annual Energy Demand Calculations

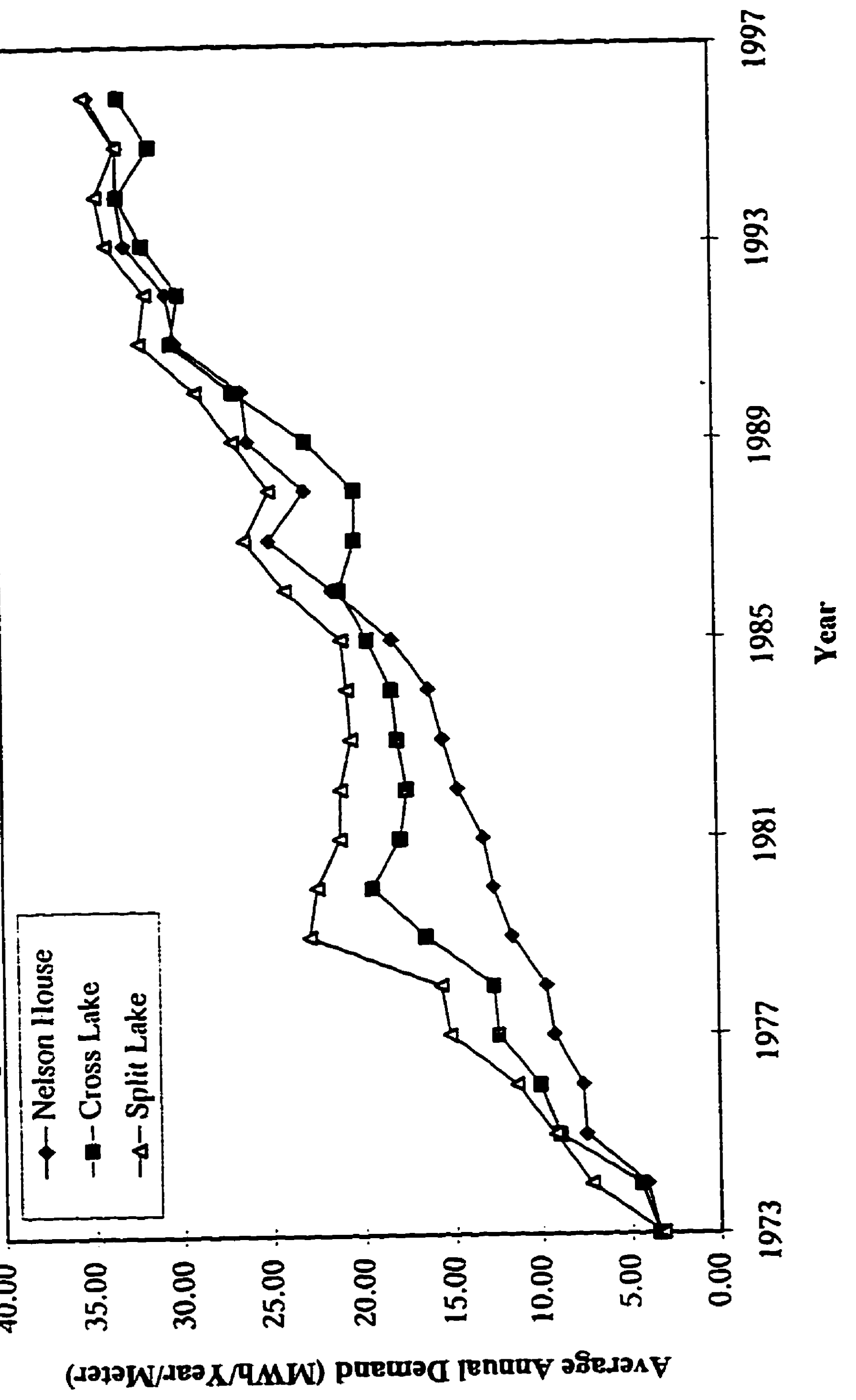

Figure B1: Historical residential demand for nonremote communities

Figure B2: Historical nonresidential demand for nonremote communiteis

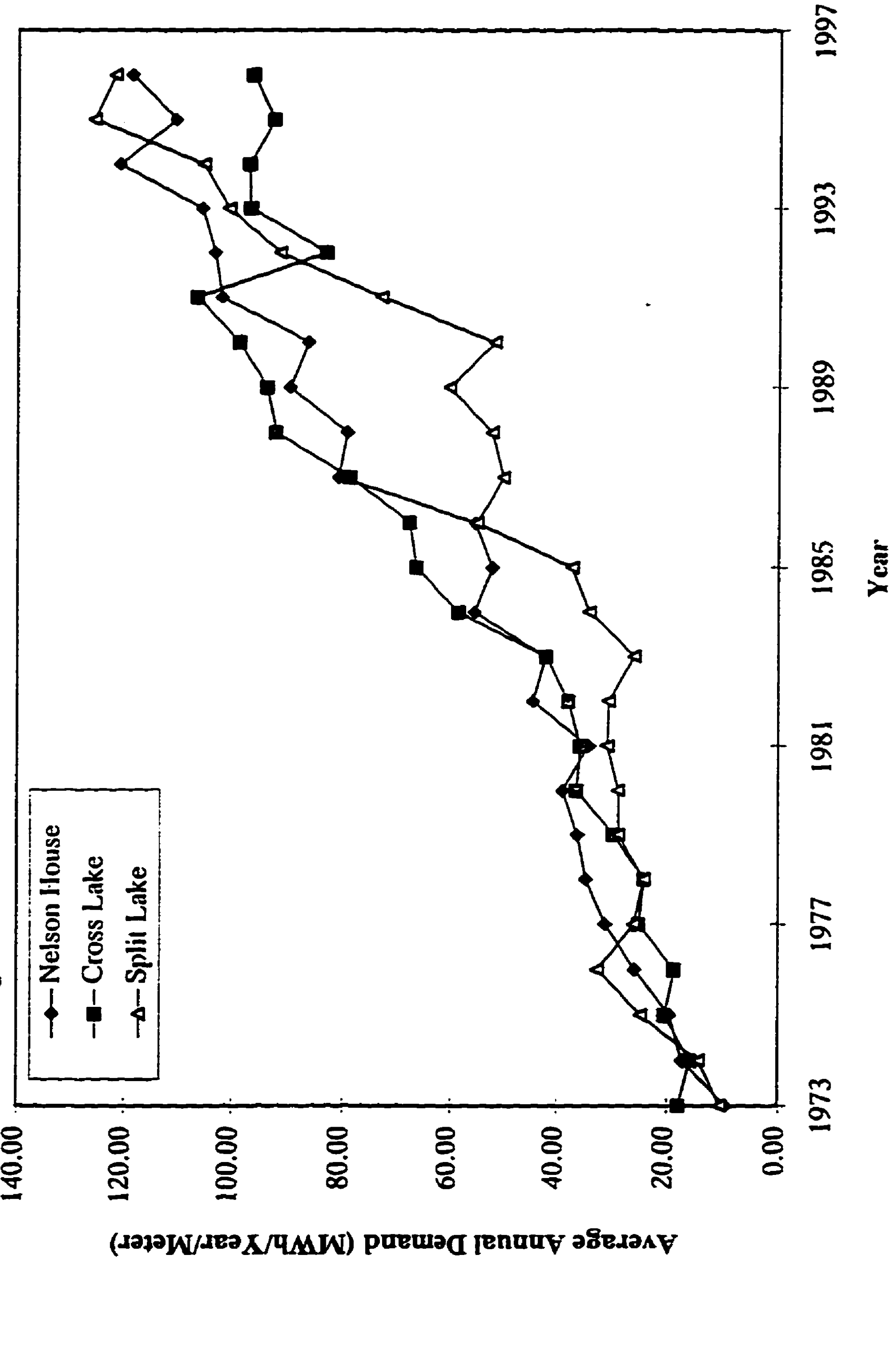

Figure B3: Historical residential demand for remote communities

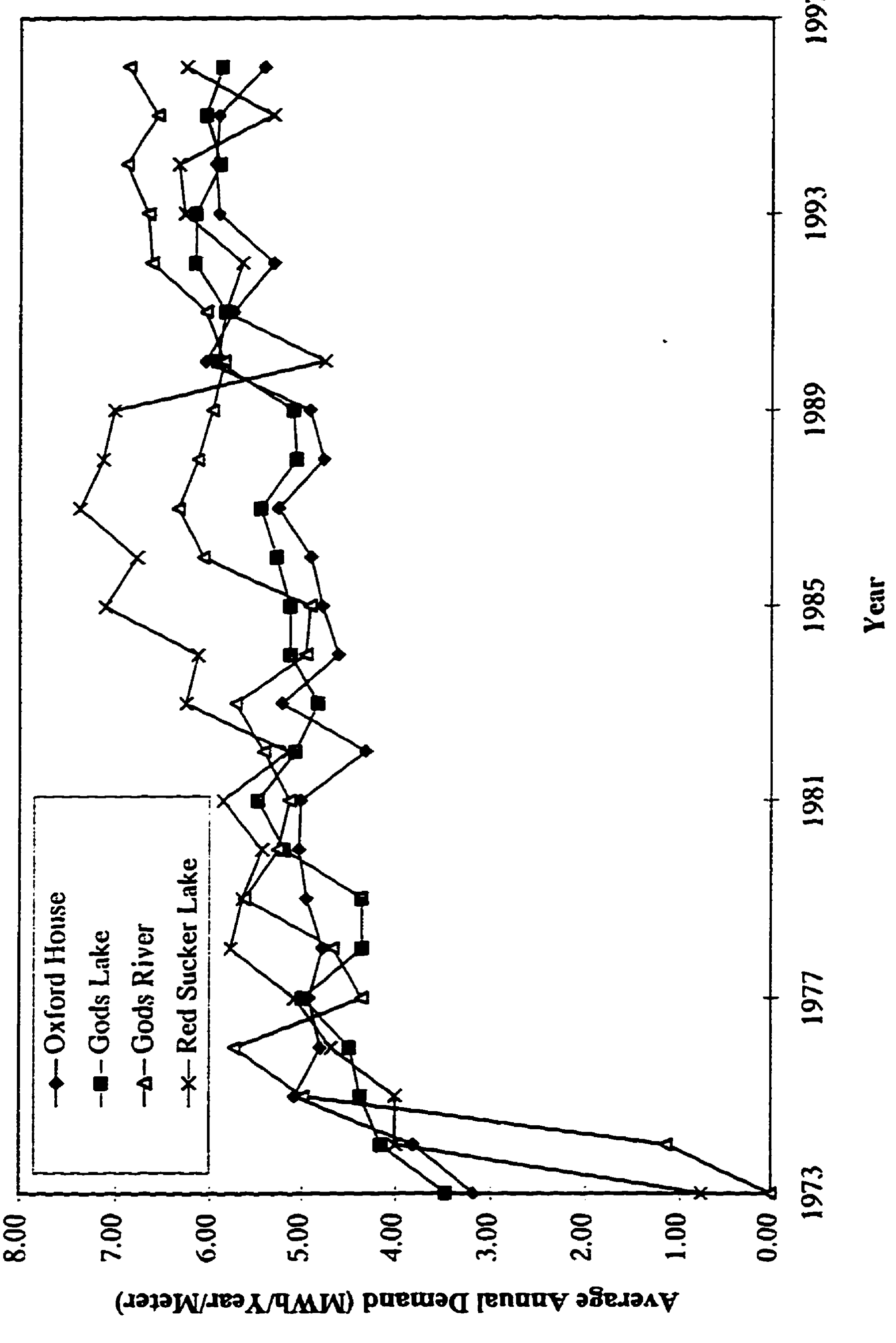

Figure B4: Historical residential demand for remote communities

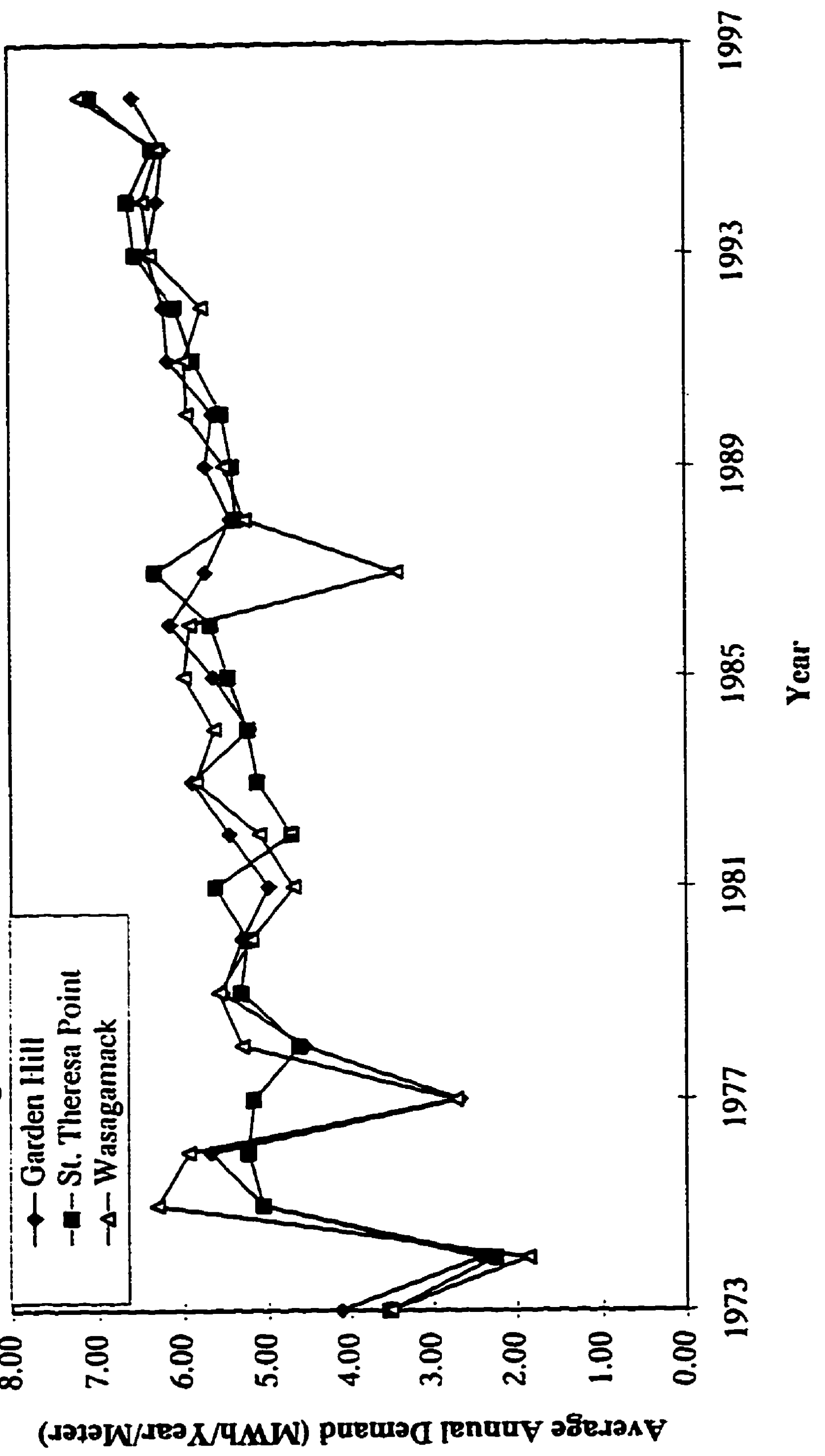

Figure B5: Historical nonresidential demand for remote communities

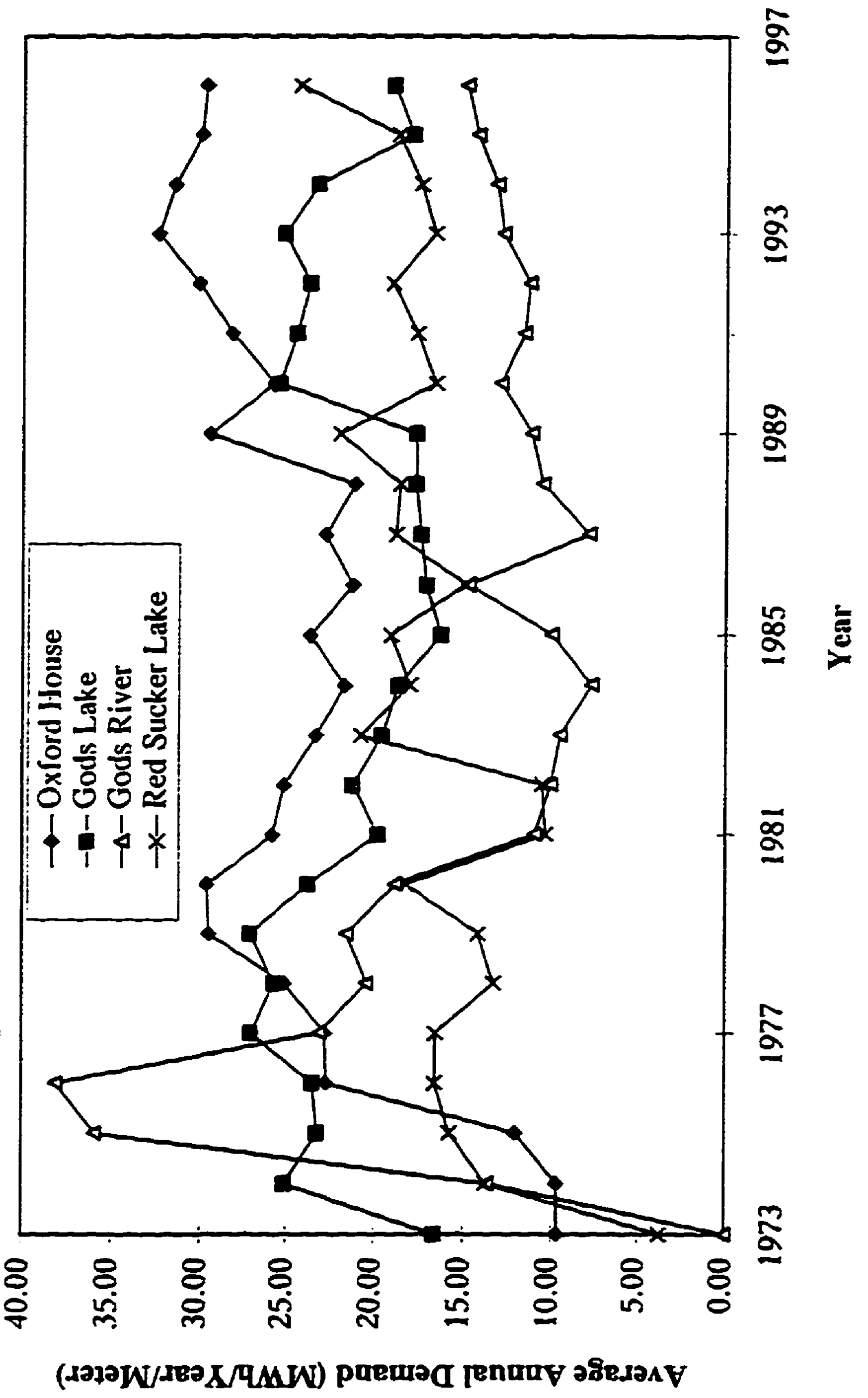

Figure B6: Historical nonresidential demand for remote communities

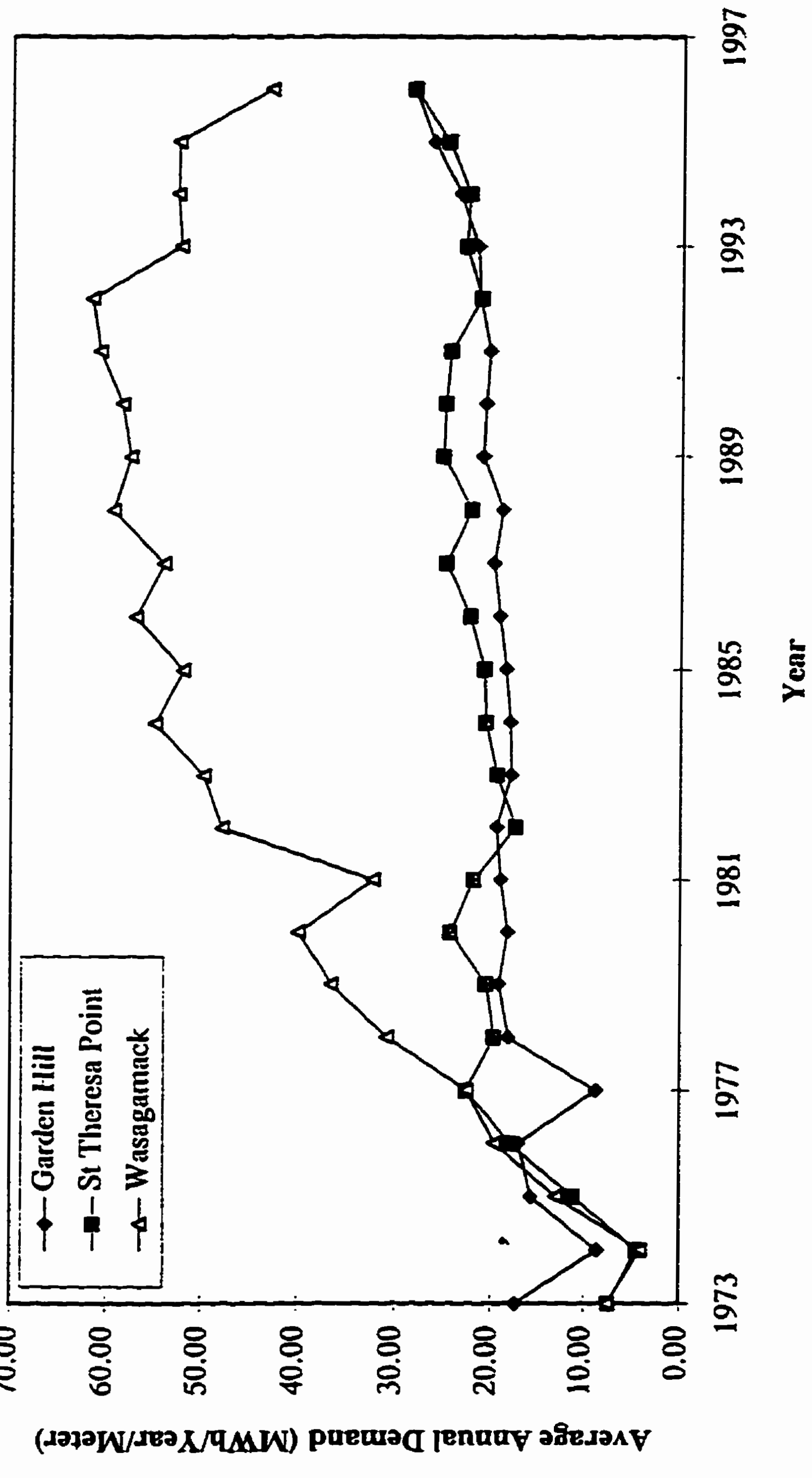

Table B1: Annual historical energy demand data for Nelson House

Fiscal Year	Residential Demand (Meters)	Residential Demand (KWh/Year)	General Service Demand (Meters)	General Service Demand (KWh/Year)	Lighting Demand (Meters)	Lighting Demand (KWh/Year)	Total Demand (KWh/Year)
1972/73	92	310872.00	30	278122.00	10	3523.00	592517.00
1973/74	104	425810.00	43	740156.00	12	7996.00	1173962.00
1974/75	112	839744.00	37	719984.00	12	9048.00	1568776.00
1975/76	134	1027408.00	30	775225.00	27	24752.00	1827385.00
1976/77	138	1276035.00	26	812906.00	29	25180.00	2114121.00
1977/78	152	1469790.00	36	1247267.00	30	25329.00	2742386.00
1978/79	154	1791686.00	34	1229749.00	30	26976.00	3048411.00
1979/80	176	2238500.00	37	1437682.00	30	26976.00	3703158.00
1980/81	181	2403358.00	48	1642493.00	30	26976.00	4072827.00
1981/82	202	2968508.00	49	2178462.00	34	28122.00	5175092.00
1982/83	212	3284076.00	52	2194748.00	44	36798.00	5515622.00
1983/84	211	3424025.00	51	2825816.00	46	41828.00	6291669.00
1984/85	244	4446002.00	58	3022614.00	49	43656.00	7512272.00
1985/86	250	5371269.00	62	3429405.00	49	44642.00	8845316.00
1986/87	236	5875728.00	53	4283256.00	49	35188.00	10194172.00
1987/88	245	5614768.00	51	4045488.00	58	49296.00	9709552.00
1988/89	259	6732807.00	55	4936308.00	51	48789.00	11717904.00
1989/90	282	7412835.00	64	5527254.00	50	44921.00	12985010.00
1990/91	296	8875553.00	64	6525540.00	53	45896.00	15446989.00
1991/92	300	9164134.00	66	6813820.00	39	42823.00	16020777.00
1992/93	317	10405249.00	65	6863480.00	41	73255.00	17341984.00
1993/94	365	12142847.00	67	8106060.00	38	73788.00	20322695.00
1994/95	363	12065101.00	69	7629450.00	36	52644.00	19747195.00
1995/96	372	12947420.00	70	8309380.00	38	54540.00	21311340.00

Table B2: Best fit of historical residential energy demand data for Nelson House

Year	Annual Number of Residential Meters (Meters)	Total Annual Residential Demand (MWh/Year)	Annual Residential Demand per Meter (MWh/Meter)	Linear Best Fit of Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Residential Demand per Meter (MWh/Meter)
1973	92	311	3.379	3.379	3.379
1974	104	426	4.094	4.759	8.739
1975	112	840	7.498	6.139	10.959
1976	134	1027	7.667	7.519	12.663
1977	138	1276	9.247	8.899	14.099
1978	152	1470	9.670	10.279	15.364
1979	154	1792	11.634	11.659	16.508
1980	176	2239	12.719	13.039	17.560
1981	181	2403	13.278	14.419	18.539
1982	202	2969	14.696	15.799	19.459
1983	212	3284	15.491	17.179	20.329
1984	211	3424	16.228	18.559	21.156
1985	244	4446	18.221	19.939	21.947
1986	250	5371	21.485	21.319	22.705
1987	236	5876	24.897	22.699	23.434
1988	245	5615	22.917	24.079	24.138
1989	259	6733	25.995	25.459	24.819
1990	282	7413	26.287	26.839	25.479
1991	296	8876	29.985	28.219	26.120
1992	300	9164	30.547	29.599	26.743
1993	317	10405	32.824	30.979	27.350
1994	365	12143	33.268	32.359	27.942
1995	363	12065	33.237	33.739	28.520
1996	372	12947	34.805	35.119	29.085
Sum of Squares Error				3.206E+01	4.235E+02

Table B3: Best fit of historical nonresidential energy demand data for Nelson House

Year	Annual Number of General Service Meters (Meters)	Total Annual Non Residential Demand (MWh/Year)	Annual Nonresidential Demand per Meter (MWh/Meter)	Linear Best Fit of Non Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Non Residential Demand per Meter (MWh/Meter)
1973	30	278	9.271	9.271	9.271
1974	43	740	17.213	13.971	10.467
1975	37	720	19.459	18.671	11.817
1976	30	775	25.841	23.371	13.341
1977	26	813	31.266	28.071	15.062
1978	36	1247	34.646	32.771	17.005
1979	34	1230	36.169	37.471	19.199
1980	37	1438	38.856	42.171	21.676
1981	48	1642	34.219	46.871	24.472
1982	49	2178	44.458	51.571	27.629
1983	52	2195	42.207	56.271	31.193
1984	51	2826	55.408	60.971	35.217
1985	58	3023	52.114	65.671	39.760
1986	62	3429	55.313	70.371	44.889
1987	53	4283	80.816	75.071	50.679
1988	51	4045	79.323	79.771	57.217
1989	55	4936	89.751	84.471	64.598
1990	64	5527	86.363	89.171	72.931
1991	64	6526	101.962	93.871	82.339
1992	66	6814	103.240	98.571	92.961
1993	65	6863	105.592	103.271	104.953
1994	67	8106	120.986	107.971	118.491
1995	69	7629	110.572	112.671	133.777
Sum of Squares Error				1.229E+03	5.831E+03

Table B4: Annual historical energy demand data for Cross Lake

Fiscal Year	Residential Demand (Meters)	Residential Demand (KWh/Year)	General Service Demand (Meters)	General Service Demand (KWh/Year)	Lighting Demand (Meters)	Lighting Demand (KWh/Year)	Total Demand (KWh/Year)
1972/73	174	593688.00	48	854034.00	20	6245.00	1453967.00
1973/74	229	1012474.00	47	739323.00	22	18984.00	1770781.00
1974/75	254	2280793.00	46	934751.00	23	19824.00	3235368.00
1975/76	281	2826165.00	58	1078471.00	23	20203.00	3924839.00
1976/77	285	3555482.00	66	1656309.00	34	29386.00	5241177.00
1977/78	316	4030454.00	75	1810488.00	37	30415.00	5871357.00
1978/79	336	5541003.00	79	2355719.00	44	34138.00	7930860.00
1979/80	365	7085956.00	80	2905501.00	50	38960.00	10030417.00
1980/81	376	6711159.00	83	2959226.00	130	81542.00	9751927.00
1981/82	401	7014062.00	83	3141828.00	163	133804.00	10289694.00
1982/83	425	7634718.00	95	3993014.00	167	145849.00	11773581.00
1983/84	467	8527049.00	99	5786177.00	186	160180.00	14473406.00
1984/85	495	9699068.00	106	7070956.00	203	176171.00	16946195.00
1985/86	531	11201364.00	111	7547828.00	199	181594.00	18930786.00
1986/87	542	10978896.00	106	8357147.00	199	130092.00	19466135.00
1987/88	574	11604326.00	88	8126975.00	192	174487.00	19905788.00
1988/89	590	13480372.00	89	8360337.00	190	175977.00	22016686.00
1989/90	641	17166096.00	89	8788218.00	204	186472.00	26140786.00
1990/91	683	20676234.00	95	10116520.00	205	185306.00	30978060.00
1991/92	730	21757475.00	96	7977000.00	221	198222.00	29932697.00
1992/93	762	24266635.00	99	9591291.00	242	209921.00	34067847.00
1993/94	788	26164448.00	105	10192611.00	259	229122.00	36586181.00
1994/95	798	25068790.00	106	9835260.00	262	145581.00	35049631.00
1995/96	838	27732880.00	114	10994389.00	264	191875.00	38919144.00

Table B5: Best fit of historical residential energy demand data for Cross Lake

Year	Annual Number of Residential Meters (Meters)	Total Annual Residential Demand (MWh/Year)	Annual Residential Demand per Meter (MWh/Meter)	Linear Best Fit of Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Residential Demand per Meter (MWh/Meter)
1973	174	594	3.412	3.412	3.412
1974	229	1012	4.421	4.782	8.812
1975	254	2281	8.980	6.152	11.049
1976	281	2826	10.058	7.522	12.765
1977	285	3555	12.475	8.892	14.212
1978	316	4030	12.755	10.262	15.487
1979	336	5541	16.491	11.632	16.639
1980	365	7086	19.414	13.002	17.699
1981	376	6711	17.849	14.372	18.686
1982	401	7014	17.491	15.742	19.612
1983	425	7635	17.964	17.112	20.488
1984	467	8527	18.259	18.482	21.322
1985	495	9699	19.594	19.852	22.118
1986	531	11201	21.095	21.222	22.882
1987	542	10979	20.256	22.592	23.617
1988	574	11604	20.217	23.962	24.326
1989	590	13480	22.848	25.332	25.012
1990	641	17166	26.780	26.702	25.677
1991	683	20676	30.273	28.072	26.322
1992	730	21757	29.805	29.442	26.950
1993	762	24267	31.846	30.812	27.562
1994	788	26164	33.204	32.182	28.158
1995	798	25069	31.415	33.552	28.740
1996	838	27733	33.094	34.922	29.309
Sum of Squares Error				1.550E+02	1.980E+02

Table B6: Best fit of historical nonresidential energy demand data for Cross Lake

Year	Annual Number of General Service Meters (Meters)	Total Annual Non Residential Demand (MWh/Year)	Annual Nonresidential Demand per Meter (MWh/Meter)	Linear Best Fit of Non Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Non Residential Demand per Meter (MWh/Meter)
1973	48	854	17.792	17.792	17.792
1974	47	739	15.730	21.692	18.712
1975	46	935	20.321	25.592	20.395
1976	58	1078	18.594	29.492	22.573
1977	66	1656	25.096	33.392	25.152
1978	75	1810	24.140	37.292	28.078
1979	79	2356	29.819	41.192	31.314
1980	80	2906	36.319	45.092	34.831
1981	83	2959	35.653	48.992	38.610
1982	83	3142	37.853	52.892	42.632
1983	95	3993	42.032	56.792	46.885
1984	99	5786	58.446	60.692	51.357
1985	106	7071	66.707	64.592	56.036
1986	111	7548	67.998	68.492	60.915
1987	106	8357	78.841	72.392	65.985
1988	88	8127	92.352	76.292	71.240
1989	89	8360	93.936	80.192	76.672
1990	89	8788	98.744	84.092	82.278
1991	95	10117	106.490	87.992	88.051
1992	96	7977	83.094	91.892	93.986
1993	99	9591	96.882	95.792	100.080
1994	105	10193	97.072	99.692	106.328
1995	106	9835	92.785	103.592	112.726
1996	114	10994	96.442	107.492	119.272
Sum of Squares Error				2.632E+03	2.968E+03

Table B7: Annual historical energy demand data for Split Lake

Fiscal Year	Residential Demand (Meters)	Residential Demand (KWh/Year)	General Service Demand (Meters)	General Service Demand (KWh/Year)	Lighting Demand (Meters)	Lighting Demand (KWh/Year)	Total Demand (KWh/Year)
1972/73	71	227305.00	25	257925.00	13	6755.00	491985.00
1973/74	88	635200.00	33	470208.00	15	12271.00	1117679.00
1974/75	97	895016.00	36	890134.00	14	12984.00	1798134.00
1975/76	100	1142687.00	34	1108578.00	13	12010.00	2263275.00
1976/77	123	1873061.00	40	1040909.00	12	12360.00	2926330.00
1977/78	133	2089101.00	48	1160465.00	13	11362.00	3260928.00
1978/79	146	3337893.00	46	1326531.00	16	12985.00	4677409.00
1979/80	149	3342842.00	44	1275254.00	33	19305.00	4637401.00
1980/81	158	3349993.00	45	1393560.00	39	31119.00	4774672.00
1981/82	166	3510057.00	44	1352306.00	53	38787.00	4901150.00
1982/83	178	3661061.00	57	1486239.00	70	56113.00	5203413.00
1983/84	179	3715381.00	44	1504135.00	71	63930.00	5283446.00
1984/85	196	4122839.00	42	1564928.00	75	65252.00	5753019.00
1985/86	198	4759945.00	31	1703307.00	74	65770.00	6529022.00
1986/87	211	5538658.00	32	1602708.00	75	52448.00	7193814.00
1987/88	219	5445877.00	33	1723029.00	79	70278.00	7239184.00
1988/89	220	5907100.00	33	1988350.00	82	72123.00	7967573.00
1989/90	229	6615578.00	51	2640600.00	82	74111.00	9330289.00
1990/91	260	8337887.00	49	3592010.00	77	74463.00	12004360.00
1991/92	278	8821470.00	42	3849700.00	77	80894.00	12752064.00
1992/93	294	9958430.00	41	4130560.00	72	76486.00	14165476.00
1993/94	289	9943700.00	39	4108850.00	54	84685.00	14137235.00
1994/95	296	9851530.00	35	4399010.00	45	70128.00	14320668.00
1995/96	303	10629780.00	43	5240750.00	46	88055.00	15958585.00

Table B8: Best fit of historical residential energy demand data for Split Lake

Year	Annual Number of Residential Meters (Meters)	Total Annual Residential Demand (MWh/Year)	Annual Residential Demand per Meter (MWh/Meter)	Linear Best Fit of Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Residential Demand per Meter (MWh/Meter)
1973	71	227	3.201	3.201	3.201
1974	88	635	7.218	4.761	9.451
1975	97	895	9.227	6.321	12.040
1976	100	1143	11.427	7.881	14.027
1977	123	1873	15.228	9.441	15.701
1978	133	2089	15.708	11.001	17.177
1979	146	3338	22.862	12.561	18.511
1980	149	3343	22.435	14.121	19.737
1981	158	3350	21.202	15.681	20.879
1982	166	3510	21.145	17.241	21.951
1983	178	3661	20.568	18.801	22.966
1984	179	3715	20.756	20.361	23.930
1985	196	4123	21.035	21.921	24.852
1986	198	4760	24.040	23.481	25.736
1987	211	5539	26.250	25.041	26.587
1988	219	5446	24.867	26.601	27.408
1989	220	5907	26.850	28.161	28.201
1990	229	6616	28.889	29.721	28.971
1991	260	8338	32.069	31.281	29.718
1992	278	8821	31.732	32.841	30.445
1993	294	9958	33.872	34.401	31.152
1994	289	9944	34.407	35.961	31.843
1995	296	9852	33.282	37.521	32.517
1996	303	10630	35.082	39.081	33.175
Sum of Squares Error				3.534E+02	1.161E+02

Table B9: Best fit of historical nonresidential energy demand data for Split Lake

Year	Annual Number of General Service Meters (Meters)	Total Annual Non Residential Demand (MWh/Year)	Annual Nonresidential Demand per Meter (MWh/Meter)	Linear Best Fit of Non Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Non Residential Demand per Meter (MWh/Meter)
1973	25	258	10.317	10.317	10.317
1974	33	470	14.249	14.117	11.237
1975	36	890	24.726	17.917	12.919
1976	34	1109	32.605	21.717	15.097
1977	40	1041	26.023	25.517	17.677
1978	48	1160	24.176	29.317	20.603
1979	46	1327	28.838	33.117	23.838
1980	44	1275	28.983	36.917	27.356
1981	45	1394	30.968	40.717	31.134
1982	44	1352	30.734	44.517	35.157
1983	57	1486	26.074	48.317	39.410
1984	44	1504	34.185	52.117	43.881
1985	42	1565	37.260	55.917	48.561
1986	31	1703	54.945	59.717	53.439
1987	32	1603	50.085	63.517	58.510
1988	33	1723	52.213	67.317	63.764
1989	33	1988	60.253	71.117	69.197
1990	51	2641	51.776	74.917	74.802
1991	49	3592	73.306	78.717	80.575
1992	42	3850	91.660	82.517	86.511
1993	41	4131	100.745	86.317	92.604
1994	39	4109	105.355	90.117	98.852
1995	35	4399	125.686	93.917	105.251
1996	43	5241	121.878	97.717	111.797
Sum of Squares Error				4.953E+03	2.508E+03

Table B10: Annual historical energy demand data for Oxford House

Fiscal	Residential Demand		General Service Demand		Lighting Demand		Total Demand
Year	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(KWh/Year)
1972/73	83	264376.00	29	279600.00	9	8532.00	552508.00
1973/74	91	347224.00	32	309519.00	11	9720.00	666463.00
1974/75	101	512726.00	36	433639.00	22	16987.00	963352.00
1975/76	107	514173.00	33	749527.00	22	20400.00	1284100.00
1976/77	105	517232.00	28	638505.00	21	19104.00	1174841.00
1977/78	137	654934.00	30	753284.00	21	18890.00	1427108.00
1978/79	162	802442.00	31	913776.00	22	20093.00	1736311.00
1979/80	170	855845.00	32	947681.00	22	19968.00	1823494.00
1980/81	173	867942.00	37	954102.00	22	19968.00	1842012.00
1981/82	177	763828.00	36	904498.00	23	19949.00	1688275.00
1982/83	187	975976.00	42	980186.00	25	22356.00	1978518.00
1983/84	202	931909.00	44	954607.00	32	24638.00	1911154.00
1984/85	226	1081636.00	48	1136027.00	39	30655.00	2248318.00
1985/86	232	1139334.00	50	1062515.00	52	39080.00	2240929.00
1986/87	237	1246043.00	49	1116878.00	61	39512.00	2402433.00
1987/88	257	1226089.00	52	1099194.00	68	56307.00	2381590.00
1988/89	259	1274853.00	50	1473079.00	67	58407.00	2806339.00
1989/90	250	1512264.00	52	1339625.00	70	61854.00	2913743.00
1990/91	275	1578680.00	54	1523620.00	80	62230.00	3164530.00
1991/92	283	1503549.00	54	1626045.00	98	78884.00	3208478.00
1992/93	283	1671721.00	56	1814706.00	107	83869.00	3570296.00
1993/94	288	1711936.00	58	1825810.00	117	95310.00	3633056.00
1994/95	305	1801611.00	60	1798933.00	114	57585.00	3658129.00
1995/96	308	1666485.00	64	1901087.00	128	59085.00	3626657.00

Table B11: Best fit of historical residential energy demand data for Oxford House

Year	Annual Number of Residential Meters (Meters)	Total Annual Residential Demand (MWh/Year)	Annual Residential Demand per Meter (MWh/Meter)	Linear Best Fit of Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Residential Demand per Meter (MWh/Meter)
1973	83	264	3.185	3.185	3.185
1974	91	347	3.816	3.325	3.235
1975	101	513	5.076	3.465	3.308
1976	107	514	4.805	3.605	3.394
1977	105	517	4.926	3.745	3.488
1978	137	655	4.781	3.885	3.590
1979	162	802	4.953	4.025	3.699
1980	170	856	5.034	4.165	3.813
1981	173	868	5.017	4.305	3.932
1982	177	764	4.315	4.445	4.055
1983	187	976	5.219	4.585	4.183
1984	202	932	4.613	4.725	4.314
1985	226	1082	4.786	4.865	4.450
1986	232	1139	4.911	5.005	4.588
1987	237	1246	5.258	5.145	4.730
1988	257	1226	4.771	5.285	4.875
1989	259	1275	4.922	5.425	5.023
1990	250	1512	6.049	5.565	5.174
1991	275	1579	5.741	5.705	5.327
1992	283	1504	5.313	5.845	5.483
1993	283	1672	5.907	5.985	5.642
1994	288	1712	5.944	6.125	5.803
1995	305	1802	5.907	6.265	5.966
1996	308	1666	5.411	6.405	6.131
Sum of Squares Error				1.125E+01	1.651E+01

Table B12: Best fit of historical nonresidential energy demand data for Oxford House

Year	Annual Number of General Service Meters (Meters)	Total Annual Non Residential Demand (MWh/Year)	Annual Nonresidential Demand per Meter (MWh/Meter)	Linear Best Fit of Non Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Non Residential Demand per Meter (MWh/Meter)
1973	29	280	9.641	9.641	9.641
1974	32	310	9.672	10.751	14.141
1975	36	434	12.046	11.861	16.005
1976	33	750	22.713	12.971	17.436
1977	28	639	22.804	14.081	18.641
1978	30	753	25.109	15.191	19.704
1979	31	914	29.477	16.301	20.664
1980	32	948	29.615	17.411	21.547
1981	37	954	25.787	18.521	22.369
1982	36	904	25.125	19.631	23.141
1983	42	980	23.338	20.741	23.872
1984	44	955	21.696	21.851	24.566
1985	48	1136	23.667	22.961	25.230
1986	50	1063	21.250	24.071	25.866
1987	49	1117	22.793	25.181	26.479
1988	52	1099	21.138	26.291	27.070
1989	50	1473	29.462	27.401	27.641
1990	52	1340	25.762	28.511	28.195
1991	54	1524	28.215	29.621	28.733
1992	54	1626	30.112	30.731	29.256
1993	56	1815	32.405	31.841	29.766
1994	58	1826	31.479	32.951	30.263
1995	60	1799	29.982	34.061	30.748
1996	64	1901	29.704	35.171	31.223
Sum of Squares Error				7.867E+02	3.710E+02

Table B13: Annual historical energy demand data for Gods Lake (and Gods Lake Narrows)

Fiscal	Residential Demand		General Service Demand		Lighting Demand		Total Demand
Year	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(KWh/Year)
1972/73	60	208803.00	35	580288.00	21	16670.00	805761.00
1973/74	59	244762.00	34	852741.00	19	17637.00	1115140.00
1974/75	66	288223.00	32	743386.00	23	15809.00	1047418.00
1975/76	75	336493.00	30	704892.00	22	17640.00	1059025.00
1976/77	70	349702.00	32	865666.00	22	16416.00	1231784.00
1977/78	84	365497.00	34	873251.00	22	16483.00	1255231.00
1978/79	124	540074.00	38	1030158.00	22	17057.00	1587289.00
1979/80	135	701167.00	51	1212611.00	24	16093.00	1929871.00
1980/81	142	776927.00	59	1167943.00	27	21129.00	1965999.00
1981/82	150	761281.00	59	1252079.00	28	20923.00	2034283.00
1982/83	157	758983.00	59	1154329.00	35	24409.00	1937721.00
1983/84	151	774769.00	74	1380550.00	43	30703.00	2186022.00
1984/85	149	764912.00	75	1220046.00	51	37574.00	2022532.00
1985/86	167	881569.00	78	1331990.00	57	42899.00	2256458.00
1986/87	172	936243.00	80	1390273.00	54	35345.00	2361861.00
1987/88	190	962361.00	81	1432110.00	56	50132.00	2444603.00
1988/89	194	989095.00	79	1394865.00	59	47355.00	2431315.00
1989/90	189	1118232.00	57	1448912.00	63	52218.00	2619362.00
1990/91	203	1183352.00	65	1589628.00	67	55554.00	2828534.00
1991/92	200	1233543.00	67	1589776.00	87	69144.00	2892463.00
1992/93	213	1312398.00	68	1710263.00	100	77337.00	3099998.00
1993/94	220	1295901.00	80	1862609.00	109	83891.00	3242401.00
1994/95	218	1319484.00	111	1983832.00	109	52431.00	3355747.00
1995/96	233	1368295.00	128	2431590.00	119	54760.00	3854645.00

Table B14: Best fit of historical residential energy demand data for Gods Lake (and Gods Lake Narrows)

Year	Annual Number of Residential Meters (Meters)	Total Annual Residential Demand (MWh/Year)	Annual Residential Demand per Meter (MWh/Meter)	Linear Best Fit of Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Residential Demand per Meter (MWh/Meter)
1973	60	209	3.480	3.480	3.480
1974	59	245	4.149	3.610	3.490
1975	66	288	4.367	3.740	3.517
1976	75	336	4.487	3.870	3.561
1977	70	350	4.996	4.000	3.619
1978	84	365	4.351	4.130	3.693
1979	124	540	4.355	4.260	3.781
1980	135	701	5.194	4.390	3.883
1981	142	777	5.471	4.520	4.000
1982	150	761	5.075	4.650	4.130
1983	157	759	4.834	4.780	4.274
1984	151	775	5.131	4.910	4.432
1985	149	765	5.134	5.040	4.603
1986	167	882	5.279	5.170	4.788
1987	172	936	5.443	5.300	4.985
1988	190	962	5.065	5.430	5.196
1989	194	989	5.098	5.560	5.420
1990	189	1118	5.917	5.690	5.657
1991	203	1183	5.829	5.820	5.907
1992	200	1234	6.168	5.950	6.169
1993	213	1312	6.161	6.080	6.445
1994	220	1296	5.890	6.210	6.733
1995	218	1319	6.053	6.340	7.033
1996	233	1368	5.873	6.470	7.346
Sum of Squares Error				4.931E+00	1.510E+01

Table B15: Best fit of historical nonresidential energy demand data for Gods Lake (and Gods Lake Narrows)

Year	Annual Number of General *Service* Meters (Meters)	Total Annual Non *Residential* Demand (MWh/Year)	Annual Nonresidential *Demand* per Meter (MWh/Meter)	Linear Best Fit of Non Residential *Demand* per Meter (MWh/Meter)	Nonlinear Best Fit of Non Residential Demand per Meter (MWh/Meter)
1973	35	580	16.580	16.580	16.580
1974	34	853	25.081	16.870	17.870
1975	32	743	23.231	17.160	18.404
1976	30	705	23.496	17.450	18.814
1977	32	866	27.052	17.740	19.160
1978	34	873	25.684	18.030	19.464
1979	38	1030	27.109	18.320	19.739
1980	51	1213	23.777	18.610	19.993
1981	59	1168	19.796	18.900	20.228
1982	59	1252	21.222	19.190	20.450
1983	59	1154	19.565	19.480	20.659
1984	74	1381	18.656	19.770	20.858
1985	75	1220	16.267	20.060	21.048
1986	78	1332	17.077	20.350	21.231
1987	80	1390	17.378	20.640	21.406
1988	81	1432	17.680	20.930	21.576
1989	79	1395	17.657	21.220	21.740
1990	57	1449	25.420	21.510	21.898
1991	65	1590	24.456	21.800	22.053
1992	67	1590	23.728	22.090	22.203
1993	68	1710	25.151	22.380	22.349
1994	80	1863	23.283	22.670	22.491
1995	111	1984	17.872	22.960	22.630
1996	128	2432	18.997	23.250	22.766
Sum of Squares Error				5.323E+02	4.277E+02

Table B16: Annual historical energy demand data for Gods River

Fiscal Year	Residential Demand (Meters)	Residential Demand (KWh/Year)	General Service Demand (Meters)	General Service Demand (KWh/Year)	Lighting Demand (Meters)	Lighting Demand (KWh/Year)	Total Demand (KWh/Year)
1972/73	0	0.00	0	0.00	0	0.00	0.00
1973/74	11	12589.00	3	40930.00	0	0.00	53519.00
1974/75	15	74827.00	3	107690.00	2	915.00	183432.00
1975/76	15	85826.00	4	152373.00	6	3960.00	242159.00
1976/77	25	108813.00	6	138630.00	10	6801.00	254244.00
1977/78	27	125961.00	6	122559.00	9	8402.00	256922.00
1978/79	28	157205.00	8	172502.00	10	8975.00	338682.00
1979/80	35	183993.00	9	169216.00	11	8909.00	362118.00
1980/81	38	195195.00	16	175792.00	14	11537.00	382524.00
1981/82	39	210971.00	18	181363.00	15	11542.00	403876.00
1982/83	42	239946.00	19	180997.00	16	12245.00	433188.00
1983/84	46	228354.00	22	169375.00	20	16221.00	413950.00
1984/85	50	245998.00	21	210409.00	20	18044.00	474451.00
1985/86	48	291487.00	14	206330.00	21	17442.00	515259.00
1986/87	49	311252.00	33	259872.00	22	13795.00	584919.00
1987/88	53	325176.00	30	316850.00	25	21716.00	663742.00
1988/89	57	340526.00	28	313967.00	21	18814.00	673307.00
1989/90	62	362487.00	32	415020.00	22	18185.00	795692.00
1990/91	64	387194.00	35	407239.00	24	21760.00	816193.00
1991/92	68	451209.00	36	408676.00	26	22510.00	882395.00
1992/93	68	453628.00	31	397925.00	26	21405.00	872958.00
1993/94	75	516665.00	32	422436.00	29	24049.00	963150.00
1994/95	79	519435.00	31	442553.00	30	14409.00	976397.00
1995/96	77	528993.00	36	536863.00	31	14840.00	1080696.00

Table B17: Best fit of historical residential energy demand data for Gods River

Year	Annual Number of Residential Meters (Meters)	Total Annual Residential Demand (MWh/Year)	Annual Residential Demand per Meter (MWh/Meter)	Linear Best Fit of Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Residential Demand per Meter (MWh/Meter)
1973	0	0	0.000	0.000	0.000
1974	11	13	1.144	0.390	0.020
1975	15	75	4.988	0.780	0.080
1976	15	86	5.722	1.170	0.180
1977	25	109	4.353	1.560	0.320
1978	27	126	4.665	1.950	0.500
1979	28	157	5.614	2.340	0.720
1980	35	184	5.257	2.730	0.980
1981	38	195	5.137	3.120	1.280
1982	39	211	5.410	3.510	1.620
1983	42	240	5.713	3.900	2.000
1984	46	228	4.964	4.290	2.420
1985	50	246	4.920	4.680	2.880
1986	48	291	6.073	5.070	3.380
1987	49	311	6.352	5.460	3.920
1988	53	325	6.135	5.850	4.500
1989	57	341	5.974	6.240	5.120
1990	62	362	5.847	6.630	5.780
1991	64	387	6.050	7.020	6.480
1992	68	451	6.635	7.410	7.220
1993	68	454	6.671	7.800	8.000
1994	75	517	6.889	8.190	8.820
1995	79	519	6.575	8.580	9.680
1996	77	529	6.870	8.970	10.580
Sum of Squares Error				9.826E+01	2.316E+02

Table B18: Best fit of historical nonresidential energy demand data for Gods River

Year	Annual Number of General Service Meters (Meters)	Total Annual Non Residential Demand (MWh/Year)	Annual Nonresidential Demand per Meter (MWh/Meter)	Linear Best Fit of Non Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Non Residential Demand per Meter (MWh/Meter)
1973	0	0	0.000	0.000	0.000
1974	3	41	13.643	0.830	3.800
1975	3	108	35.897	1.660	5.374
1976	4	152	38.093	2.490	6.582
1977	6	139	23.105	3.320	7.600
1978	6	123	20.427	4.150	8.497
1979	8	173	21.563	4.980	9.308
1980	9	169	18.802	5.810	10.054
1981	16	176	10.987	6.640	10.748
1982	18	181	10.076	7.470	11.400
1983	19	181	9.526	8.300	12.017
1984	22	169	7.699	9.130	12.603
1985	21	210	10.019	9.960	13.164
1986	14	206	14.738	10.790	13.701
1987	33	260	7.875	11.620	14.218
1988	30	317	10.562	12.450	14.717
1989	28	314	11.213	13.280	15.200
1990	32	415	12.969	14.110	15.668
1991	35	407	11.635	14.940	16.122
1992	36	409	11.352	15.770	16.564
1993	31	398	12.836	16.600	16.994
1994	32	422	13.201	17.430	17.414
1995	31	443	14.276	18.260	17.824
1996	36	537	14.913	19.090	18.224
Sum of Squares Error				3.868E+03	2.861E+03

Table B19: Annual historical energy demand data for Red Sucker Lake

Fiscal	Residential Demand		General Service Demand		Lighting Demand		Total Demand
Year	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(KWh/Year)
1972/73	31	23498.00	7	26099.00	9	322.00	49919.00
1973/74	31	124083.00	7	96097.00	13	9736.00	229916.00
1974/75	32	128138.00	8	125829.00	14	11906.00	265873.00
1975/76	39	182706.00	10	165474.00	12	11808.00	359988.00
1976/77	41	208340.00	13	214713.00	12	11023.00	434076.00
1977/78	46	265287.00	16	212720.00	13	11033.00	489040.00
1978/79	46	259415.00	18	255039.00	11	10696.00	525150.00
1979/80	51	276822.00	16	291040.00	12	10432.00	578294.00
1980/81	50	292494.00	32	331400.00	12	9910.00	633804.00
1981/82	52	267785.00	30	316875.00	12	9586.00	594246.00
1982/83	54	338492.00	21	436603.00	15	11931.00	787026.00
1983/84	54	331361.00	21	378019.00	18	14501.00	723881.00
1984/85	51	362867.00	21	400842.00	25	15879.00	779588.00
1985/86	51	345876.00	23	343033.00	22	18977.00	707886.00
1986/87	48	354208.00	22	414347.00	20	13886.00	782441.00
1987/88	44	314102.00	21	390140.00	19	17058.00	721300.00
1988/89	44	308909.00	24	527791.00	21	17713.00	854413.00
1989/90	99	471574.00	25	414747.00	30	23435.00	909756.00
1990/91	87	506859.00	26	458479.00	31	25487.00	990825.00
1991/92	95	536597.00	27	513296.00	32	28420.00	1078313.00
1992/93	97	609900.00	31	515448.00	32	24868.00	1150216.00
1993/94	100	635128.00	35	609976.00	36	28876.00	1273980.00
1994/95	133	707823.00	38	710472.00	37	19089.00	1437384.00
1995/96	128	802565.00	42	1020224.00	37	19357.00	1842146.00

Table B20: Best fit of historical residential energy demand data for Red Sucker Lake

Year	Annual Number of Residential Meters (Meters)	Total Annual Residential Demand (MWh/Year)	Annual Residential Demand per Meter (MWh/Meter)	Linear Best Fit of Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Residential Demand per Meter (MWh/Meter)
1973	31	23	0.758	0.758	0.758
1974	31	124	4.003	1.098	2.158
1975	32	128	4.004	1.438	2.738
1976	39	183	4.685	1.778	3.183
1977	41	208	5.081	2.118	3.558
1978	46	265	5.767	2.458	3.888
1979	46	259	5.639	2.798	4.187
1980	51	277	5.428	3.138	4.462
1981	50	292	5.850	3.478	4.718
1982	52	268	5.150	3.818	4.958
1983	54	338	6.268	4.158	5.185
1984	54	331	6.136	4.498	5.401
1985	51	363	7.115	4.838	5.608
1986	51	346	6.782	5.178	5.806
1987	48	354	7.379	5.518	5.996
1988	44	314	7.139	5.858	6.180
1989	44	309	7.021	6.198	6.358
1990	99	472	4.763	6.538	6.530
1991	87	507	5.826	6.878	6.698
1992	95	537	5.648	7.218	6.860
1993	97	610	6.288	7.558	7.019
1994	100	635	6.351	7.898	7.174
1995	133	708	5.322	8.238	7.325
1996	128	803	6.270	8.578	7.472
Sum of Squares Error				1.092E+02	3.770E+01

Table B21: Best fit of historical nonresidential energy demand data for Red Sucker Lake

Year	Annual Number of General Service Meters (Meters)	Total Annual Non Residential Demand (MWh/Year)	Annual Nonresidential Demand per Meter (MWh/Meter)	Linear Best Fit of Non Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Non Residential Demand per Meter (MWh/Meter)
1973	7	26	3.728	3.728	3.728
1974	7	96	13.728	4.638	7.528
1975	8	126	15.729	5.548	9.102
1976	10	165	16.547	6.458	10.310
1977	13	215	16.516	7.368	11.328
1978	16	213	13.295	8.278	12.225
1979	18	255	14.169	9.188	13.036
1980	16	291	18.190	10.098	13.782
1981	32	331	10.356	11.008	14.476
1982	30	317	10.563	11.918	15.128
1983	21	437	20.791	12.828	15.745
1984	21	378	18.001	13.738	16.332
1985	21	401	19.088	14.648	16.892
1986	23	343	14.914	15.558	17.430
1987	22	414	18.834	16.468	17.947
1988	21	390	18.578	17.378	18.446
1989	24	528	21.991	18.288	18.928
1990	25	415	16.590	19.198	19.396
1991	26	458	17.634	20.108	19.850
1992	27	513	19.011	21.018	20.292
1993	31	515	16.627	21.928	20.723
1994	35	610	17.428	22.838	21.142
1995	38	710	18.697	23.748	21.552
1996	42	1020	24.291	24.658	21.953
Sum of Squares Error				7.119E+02	3.160E+02

Table B22: Annual historical energy demand data for Garden Hill

Fiscal	Residential Demand		General Service Demand		Lighting Demand		Total Demand
Year	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(KWh/Year)
1972/73	113	465422.00	46	794719.00	45	29568.00	1289709.00
1973/74	224	542019.00	102	879129.00	86	32499.00	1453647.00
1974/75	116	586867.00	67	1048087.00	44	32436.00	1667390.00
1975/76	117	663832.00	68	1153750.00	47	34664.00	1852246.00
1976/77	245	651044.00	145	1272399.00	88	35982.00	1959425.00
1977/78	211	961927.00	87	1576294.00	57	41608.00	2579829.00
1978/79	213	1178442.00	82	1569780.00	70	52501.00	2800723.00
1979/80	218	1155197.00	86	1567432.00	84	61797.00	2784426.00
1980/81	254	1266102.00	85	1613631.00	105	73067.00	2952800.00
1981/82	265	1442174.00	86	1668289.00	126	97332.00	3207795.00
1982/83	260	1529733.00	89	1588277.00	137	110729.00	3228739.00
1983/84	280	1456075.00	85	1528441.00	137	103260.00	3087776.00
1984/85	303	1704494.00	85	1564902.00	135	106482.00	3375878.00
1985/86	299	1835045.00	98	1877870.00	158	135153.00	3848068.00
1986/87	307	1754036.00	94	1863644.00	150	97021.00	3714701.00
1987/88	300	1624422.00	91	1722387.00	150	124394.00	3471203.00
1988/89	309	1764974.00	92	1930715.00	147	122268.00	3817957.00
1989/90	345	1940796.00	89	1842974.00	149	123782.00	3907552.00
1990/91	352	2162817.00	97	1968288.00	149	128889.00	4259994.00
1991/92	362	2243328.00	100	2126744.00	163	137810.00	4507882.00
1992/93	388	2477100.00	101	2178312.00	185	142918.00	4798330.00
1993/94	403	2525749.00	111	2599467.00	180	154268.00	5279484.00
1994/95	436	2703296.00	109	2853852.00	175	93223.00	5650371.00
1995/96	422	2767385.00	107	3035635.00	184	91623.00	5894643.00

Table B23: Best fit of historical residential energy demand data for Garden Hill

Year	Annual Number of Residential Meters (Meters)	Total Annual Residential Demand (MWh/Year)	Annual Residential Demand per Meter (MWh/Meter)	Linear Best Fit of Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Residential Demand per Meter (MWh/Meter)
1973	113	465	4.119	4.119	4.119
1974	224	542	2.420	4.229	4.149
1975	116	587	5.059	4.339	4.204
1976	117	664	5.674	4.449	4.275
1977	245	651	2.657	4.559	4.359
1978	211	962	4.559	4.669	4.454
1979	213	1178	5.533	4.779	4.560
1980	218	1155	5.299	4.889	4.674
1981	254	1266	4.985	4.999	4.798
1982	265	1442	5.442	5.109	4.929
1983	260	1530	5.884	5.219	5.067
1984	280	1456	5.200	5.329	5.213
1985	303	1704	5.625	5.439	5.366
1986	299	1835	6.137	5.549	5.525
1987	307	1754	5.713	5.659	5.690
1988	300	1624	5.415	5.769	5.862
1989	309	1765	5.712	5.879	6.039
1990	345	1941	5.625	5.989	6.222
1991	352	2163	6.144	6.099	6.410
1992	362	2243	6.197	6.209	6.603
1993	388	2477	6.384	6.319	6.802
1994	403	2526	6.267	6.429	7.006
1995	436	2703	6.200	6.539	7.214
1996	422	2767	6.558	6.649	7.428
Sum of Squares Error				1.105E+01	1.473E+01

Table B24: Best fit of historical nonresidential energy demand data for Nelson House

Year	Annual Number of General Service Meters (Meters)	Total Annual Non Residential Demand (MWh/Year)	Annual Nonresidential Demand per Meter (MWh/Meter)	Linear Best Fit of Non Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Non Residential Demand per Meter (MWh/Meter)
1973	46	795	17.277	17.277	17.277
1974	102	879	8.619	17.527	18.087
1975	67	1048	15.643	17.777	18.422
1976	68	1154	16.967	18.027	18.679
1977	145	1272	8.775	18.277	18.897
1978	87	1576	18.118	18.527	19.088
1979	82	1570	19.144	18.777	19.261
1980	86	1567	18.226	19.027	19.420
1981	85	1614	18.984	19.277	19.568
1982	86	1668	19.399	19.527	19.707
1983	89	1588	17.846	19.777	19.838
1984	85	1528	17.982	20.027	19.963
1985	85	1565	18.411	20.277	20.082
1986	98	1878	19.162	20.527	20.197
1987	94	1864	19.826	20.777	20.307
1988	91	1722	18.927	21.027	20.414
1989	92	1931	20.986	21.277	20.517
1990	89	1843	20.708	21.527	20.616
1991	97	1968	20.292	21.777	20.713
1992	100	2127	21.267	22.027	20.807
1993	101	2178	21.567	22.277	20.899
1994	111	2599	23.419	22.527	20.988
1995	109	2854	26.182	22.777	21.076
1996	107	3036	28.370	23.027	21.161
Sum of Squares Error				2.399E+02	3.048E+02

Table B25: Annual historical energy demand data for St. Theresa Point

Fiscal	Residential Demand		General Service Demand		Lighting Demand		Total Demand
Year	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(KWh/Year)
1972/73	98	345097.00	27	200603.00	24	18141.00	563841.00
1973/74	193	433680.00	54	242243.00	53	20196.00	696119.00
1974/75	101	510697.00	34	379337.00	30	21955.00	911989.00
1975/76	102	533681.00	33	591442.00	29	25407.00	1150530.00
1976/77	104	537380.00	33	743761.00	26	22458.00	1303599.00
1977/78	126	582087.00	34	669058.00	23	16901.00	1268046.00
1978/79	138	733185.00	33	675659.00	23	12505.00	1421349.00
1979/80	150	785372.00	31	750434.00	23	12138.00	1547944.00
1980/81	151	847341.00	35	761442.00	28	20241.00	1629024.00
1981/82	191	899090.00	49	850220.00	38	25750.00	1775060.00
1982/83	211	1078952.00	49	951645.00	49	35570.00	2066167.00
1983/84	221	1154429.00	48	987990.00	64	47623.00	2190042.00
1984/85	244	1329351.00	49	1015102.00	77	57682.00	2402135.00
1985/86	245	1384910.00	46	1022651.00	73	60588.00	2468149.00
1986/87	256	1613945.00	47	1163887.00	75	45239.00	2823071.00
1987/88	255	1364886.00	48	1062082.00	72	59274.00	2486242.00
1988/89	275	1484206.00	49	1230747.00	73	58683.00	2773636.00
1989/90	299	1649536.00	53	1317991.00	75	62855.00	3030382.00
1990/91	310	1814335.00	58	1412850.00	80	65853.00	3293038.00
1991/92	314	1905205.00	65	1376008.00	84	69388.00	3350601.00
1992/93	323	2110236.00	66	1503419.00	86	69955.00	3683610.00
1993/94	338	2236146.00	75	1680816.00	79	66187.00	3983149.00
1994/95	353	2233253.00	77	1897352.00	70	36242.00	4166847.00
1995/96	359	2535033.00	73	2060749.00	81	38624.00	4634406.00

Table B26: Best fit of historical residential energy demand data for St. Theresa Point

Year	Annual Number of Residential Meters (Meters)	Total Annual Residential Demand (MWh/Year)	Annual Residential Demand per Meter (MWh/Meter)	Linear Best Fit of Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Residential Demand per Meter (MWh/Meter)
1973	98	345	3.521	3.521	3.521
1974	193	434	2.247	3.671	4.521
1975	101	511	5.056	3.821	4.753
1976	102	534	5.232	3.971	4.912
1977	104	537	5.167	4.121	5.037
1978	126	582	4.620	4.271	5.142
1979	138	733	5.313	4.421	5.233
1980	150	785	5.236	4.571	5.314
1981	151	847	5.612	4.721	5.387
1982	191	899	4.707	4.871	5.455
1983	211	1079	5.114	5.021	5.517
1984	221	1154	5.224	5.171	5.575
1985	244	1329	5.448	5.321	5.629
1986	245	1385	5.653	5.471	5.680
1987	256	1614	6.304	5.621	5.729
1988	255	1365	5.352	5.771	5.775
1989	275	1484	5.397	5.921	5.819
1990	299	1650	5.517	6.071	5.861
1991	310	1814	5.853	6.221	5.901
1992	314	1905	6.068	6.371	5.940
1993	323	2110	6.533	6.521	5.978
1994	338	2236	6.616	6.671	6.014
1995	353	2233	6.326	6.821	6.049
1996	359	2535	7.061	6.971	6.083
Sum of Squares Error				1.018E+01	9.127E+00

Table B27: Best fit of historical nonresidential energy demand data for St. Theresa Point

Year	Annual Number of General Service Meters (Meters)	Total Annual Non Residential Demand (MWh/Year)	Annual Nonresidential Demand per Meter (MWh/Meter)	Linear Best Fit of Non Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Non Residential Demand per Meter (MWh/Meter)
1973	27	201	7.430	7.430	7.430
1974	54	242	4.486	8.400	11.530
1975	34	379	11.157	9.370	13.228
1976	33	591	17.922	10.340	14.531
1977	33	744	22.538	11.310	15.630
1978	34	669	19.678	12.280	16.598
1979	33	676	20.475	13.250	17.473
1980	31	750	24.208	14.220	18.277
1981	35	761	21.755	15.190	19.026
1982	49	850	17.351	16.160	19.730
1983	49	952	19.421	17.130	20.395
1984	48	988	20.583	18.100	21.028
1985	49	1015	20.716	19.070	21.633
1986	46	1023	22.232	20.040	22.213
1987	47	1164	24.764	21.010	22.771
1988	48	1062	22.127	21.980	23.309
1989	49	1231	25.117	22.950	23.830
1990	53	1318	24.868	23.920	24.334
1991	58	1413	24.359	24.890	24.825
1992	65	1376	21.169	25.860	25.301
1993	66	1503	22.779	26.830	25.765
1994	75	1681	22.411	27.800	26.218
1995	77	1897	24.641	28.770	26.660
1996	73	2061	28.229	29.740	27.093
Sum of Squares Error				5.790E+02	2.353E+02

Table B28: Annual historical energy demand data for Wasagamack

Fiscal	Residential Demand		General Service Demand		Lighting Demand		Total Demand
Year	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(Meters)	(KWh/Year)	(KWh/Year)
1972/73	25	87820.00	9	68168.00	13	5604.00	161592.00
1973/74	60	111809.00	22	89478.00	26	7289.00	208576.00
1974/75	34	214285.00	15	194504.00	12	6586.00	415375.00
1975/76	32	189950.00	15	293710.00	12	6886.00	490546.00
1976/77	79	213774.00	30	674324.00	26	4501.00	892599.00
1977/78	38	201473.00	25	770012.00	13	4320.00	975805.00
1978/79	39	217405.00	24	877035.00	14	4668.00	1099108.00
1979/80	60	311541.00	21	837735.00	15	5287.00	1154563.00
1980/81	85	398485.00	23	741142.00	26	10423.00	1150050.00
1981/82	89	453126.00	15	716066.00	27	14720.00	1183912.00
1982/83	86	501654.00	16	795326.00	30	19834.00	1316814.00
1983/84	97	544504.00	16	878398.00	34	21413.00	1444315.00
1984/85	108	645083.00	16	830994.00	43	26656.00	1502733.00
1985/86	118	696693.00	16	910854.00	51	32997.00	1640544.00
1986/87	111	379309.00	17	918601.00	51	27324.00	1325234.00
1987/88	110	577817.00	16	949528.00	43	32512.00	1559857.00
1988/89	120	658556.00	17	978129.00	45	30265.00	1666950.00
1989/90	113	670051.00	18	1051797.00	42	30352.00	1752200.00
1990/91	123	732522.00	16	972861.00	41	28495.00	1733878.00
1991/92	133	765259.00	16	985823.00	40	30534.00	1781616.00
1992/93	132	838748.00	19	993776.00	45	27967.00	1860491.00
1993/94	153	985544.00	21	1105840.00	44	30796.00	2122180.00
1994/95	161	1006382.00	23	1209473.00	50	20649.00	2236504.00
1995/96	166	1193793.00	28	1202076.00	55	21697.00	2417566.00

Table B29: Best fit of historical residential energy demand data for Nelson House

Year	Annual Number of Residential Meters (Meters)	Total Annual Residential Demand (MWh/Year)	Annual Residential Demand per Meter (MWh/Meter)	Linear Best Fit of Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Residential Demand per Meter (MWh/Meter)
1973	25	88	3.513	3.513	3.513
1974	60	112	1.863	3.653	4.513
1975	34	214	6.303	3.793	4.744
1976	32	190	5.936	3.933	4.903
1977	79	214	2.706	4.073	5.029
1978	38	201	5.302	4.213	5.133
1979	39	217	5.574	4.353	5.225
1980	60	312	5.192	4.493	5.306
1981	85	398	4.688	4.633	5.379
1982	89	453	5.091	4.773	5.446
1983	86	502	5.833	4.913	5.508
1984	97	545	5.613	5.053	5.566
1985	108	645	5.973	5.193	5.620
1986	118	697	5.904	5.333	5.671
1987	111	379	3.417	5.473	5.720
1988	110	578	5.253	5.613	5.766
1989	120	659	5.488	5.753	5.810
1990	113	670	5.930	5.893	5.852
1991	123	733	5.955	6.033	5.893
1992	133	765	5.754	6.173	5.932
1993	132	839	6.354	6.313	5.969
1994	153	986	6.441	6.453	6.005
1995	161	1006	6.251	6.593	6.041
1996	166	1194	7.192	6.733	6.074
Sum of Squares Error				2.569E+01	2.430E+01

Table B30: Best fit of historical nonresidential energy demand data for Nelson House

Year	Annual Number of General Service Meters (Meters)	Total Annual Non Residential Demand (MWh/Year)	Annual Nonresidential Demand per Meter (MWh/Meter)	Linear Best Fit of Non Residential Demand per Meter (MWh/Meter)	Nonlinear Best Fit of Non Residential Demand per Meter (MWh/Meter)
1973	9	68	7.574	7.574	7.574
1974	22	89	4.067	10.374	18.874
1975	15	195	12.967	13.174	23.555
1976	15	294	19.581	15.974	27.146
1977	30	674	22.477	18.774	30.174
1978	25	770	30.800	21.574	32.842
1979	24	877	36.543	24.374	35.253
1980	21	838	39.892	27.174	37.471
1981	23	741	32.224	29.974	39.535
1982	15	716	47.738	32.774	41.474
1983	16	795	49.708	35.574	43.308
1984	16	878	54.900	38.374	45.052
1985	16	831	51.937	41.174	46.719
1986	16	911	56.928	43.974	48.317
1987	17	919	54.035	46.774	49.855
1988	16	950	59.346	49.574	51.339
1989	17	978	57.537	52.374	52.774
1990	18	1052	58.433	55.174	54.165
1991	16	973	60.804	57.974	55.516
1992	16	986	61.614	60.774	56.830
1993	19	994	52.304	63.574	58.109
1994	21	1106	52.659	66.374	59.357
1995	23	1209	52.586	69.174	60.576
1996	28	1202	42.931	71.974	61.767
Sum of Squares Error				3.075E+03	1.462E+03

Table B31: Demand Coefficients from best fit to historical res. demand data

	DIESEL ALT.			LAND LINE ALT.		
COMMUNITY	a	b	c	a	b	c
Nelson House	5.36	0.50	3.38	5.36	0.50	3.38
Cross Lake	5.38	0.50	3.41	5.38	0.50	3.41
Split Lake	6.25	0.50	3.20	6.25	0.50	3.20
Oxford House	0.14	1.00	3.19	5.80	0.50	6.41
Gods Lake Narrows	0.13	1.00	3.48	5.80	0.50	6.47
Gods River	0.39	1.00	0.00	5.80	0.50	8.97
Red Sucker Lake	0.34	1.00	0.76	5.80	0.50	8.58
Garden Hill	0.11	1.00	4.12	5.80	0.50	6.65
St. Theresa Point	0.15	1.00	3.52	5.80	0.50	6.97
Wasagamack	0.14	1.00	3.51	5.80	0.50	6.73

Table B32: Demand Coefficients from best fit to historical nonres. demand data

	DIESEL ALT.			LAND LINE ALT.		
COMMUNITY	a	b	c	a	b	c
Nelson House	4.70	1.00	9.27	4.70	1.00	9.27
Cross Lake	3.90	1.00	17.79	3.90	1.00	17.79
Split Lake	0.92	1.50	10.32	0.92	1.50	10.32
Oxford House	4.50	0.50	9.64	4.30	1.00	31.22
Gods Lake Narrows	1.29	0.50	16.58	4.30	1.00	22.77
Gods River	3.80	0.50	0.00	4.30	1.00	18.22
Red Sucker Lake	3.80	0.50	3.73	4.30	1.00	21.95
Garden Hill	0.25	1.00	17.28	4.30	1.00	23.03
St. Theresa Point	4.10	0.50	7.43	4.30	1.00	27.09
Wasagamack	11.30	0.50	7.57	4.30	1.00	61.77

Appendix C:

Unit Energy Cost Calculations

Table C1: Diesel Alt. - unit energy costs in 1993$/MWh for residential consumers

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	52.61	52.63	52.05	85.01	84.64	74.49	75.69	83.66	82.02	83.22
1997	52.52	52.55	51.97	84.22	83.92	73.39	74.64	83.08	81.31	82.50
1998	52.44	52.46	51.89	83.47	83.23	72.38	73.67	82.52	80.63	81.82
1999	52.36	52.38	51.82	82.74	82.57	71.45	72.77	81.98	79.97	81.16
2000	52.29	52.31	51.76	82.05	81.93	70.59	71.93	81.46	79.34	80.53
2001	52.22	52.24	51.69	81.38	81.31	69.79	71.14	80.95	78.74	79.92
2002	52.15	52.17	51.63	80.74	80.72	69.05	70.41	80.46	78.16	79.33
2003	52.09	52.10	51.58	80.13	80.15	68.36	69.72	79.98	77.60	78.77
2004	52.03	52.04	51.52	79.53	79.59	67.71	69.07	79.52	77.06	78.22
2005	51.97	51.98	51.47	78.96	79.06	67.10	68.46	79.06	76.54	77.70
2006	51.91	51.93	51.42	78.41	78.54	66.52	67.89	78.63	76.03	77.19
2007	51.86	51.87	51.37	77.88	78.05	65.99	67.34	78.20	75.55	76.70
2008	51.81	51.82	51.32	77.36	77.56	65.48	66.83	77.79	75.08	76.23
2009	51.76	51.77	51.28	76.87	77.09	65.00	66.34	77.38	74.63	75.77
2010	51.71	51.72	51.24	76.39	76.64	64.54	65.88	76.99	74.19	75.32
2011	51.66	51.68	51.20	75.92	76.20	64.11	65.44	76.61	73.77	74.89
2012	51.62	51.63	51.16	75.47	75.78	63.71	65.02	76.24	73.36	74.48
2013	51.58	51.59	51.12	75.04	75.36	63.32	64.63	75.88	72.97	74.07
2014	51.53	51.55	51.08	74.62	74.96	62.95	64.25	75.52	72.58	73.68
2015	51.49	51.51	51.05	74.21	74.57	62.60	63.88	75.18	72.21	73.30
2016	51.46	51.47	51.01	73.82	74.20	62.26	63.54	74.85	71.85	72.93
2017	51.42	51.43	50.98	73.43	73.83	61.95	63.21	74.52	71.50	72.58
2018	51.38	51.40	50.95	73.06	73.47	61.64	62.89	74.20	71.16	72.23
2019	51.35	51.36	50.92	72.70	73.13	61.35	62.58	73.89	70.83	71.89
2020	51.31	51.33	50.89	72.35	72.79	61.07	62.29	73.58	70.51	71.56
2021	51.28	51.30	50.86	72.01	72.46	60.80	62.01	73.29	70.19	71.24
2022	51.25	51.26	50.83	71.67	72.14	60.54	61.74	73.00	69.89	70.93
2023	51.22	51.23	50.80	71.35	71.83	60.30	61.48	72.71	69.60	70.63
2024	51.19	51.20	50.77	71.04	71.52	60.06	61.23	72.44	69.31	70.34
2025	51.16	51.17	50.75	70.73	71.23	59.83	60.99	72.17	69.03	70.05
2026	51.13	51.14	50.72	70.44	70.94	59.61	60.76	71.90	68.76	69.77
2027	51.10	51.12	50.70	70.15	70.66	59.40	60.54	71.64	68.49	69.50
2028	51.08	51.09	50.67	69.86	70.38	59.20	60.32	71.39	68.23	69.23
2029	51.05	51.06	50.65	69.59	70.12	59.00	60.12	71.14	67.98	68.97
2030	51.02	51.04	50.63	69.32	69.85	58.81	59.91	70.90	67.74	68.72
2031	51.00	51.01	50.61	69.06	69.60	58.63	59.72	70.66	67.50	68.47
2032	50.97	50.99	50.58	68.80	69.35	58.45	59.53	70.43	67.26	68.23
2033	50.95	50.96	50.56	68.56	69.11	58.28	59.35	70.20	67.03	68.00
2034	50.93	50.94	50.54	68.31	68.87	58.12	59.17	69.98	66.81	67.77
2035	50.90	50.92	50.52	68.08	68.63	57.96	59.00	69.76	66.59	67.54
2036	50.88	50.89	50.50	67.84	68.41	57.80	58.84	69.54	66.38	67.32
2037	50.86	50.87	50.48	67.62	68.18	57.65	58.68	69.33	66.17	67.11

Table C2: Diesel Alt. - unit energy costs in 1993$/MWh for nonresidential consumers

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	45.86	45.46	45.676	431.82	434.19	436.36	434.51	434.09	432.79	428.67
1997	45.69	45.29	45.420	431.73	434.13	436.13	434.35	433.99	432.68	428.61
1998	45.54	45.14	45.188	431.64	434.09	435.92	434.20	433.90	432.57	428.55
1999	45.40	45.00	44.975	431.55	434.04	435.71	434.06	433.81	432.47	428.50
2000	45.26	44.87	44.780	431.47	433.99	435.52	433.92	433.73	432.37	428.45
2001	45.13	44.74	44.601	431.40	433.95	435.34	433.79	433.64	432.28	428.40
2002	45.02	44.63	44.436	431.32	433.90	435.17	433.67	433.56	432.19	428.36
2003	44.90	44.52	44.283	431.25	433.86	435.01	433.55	433.48	432.11	428.31
2004	44.80	44.41	44.142	431.18	433.82	434.85	433.44	433.40	432.02	428.27
2005	44.70	44.32	44.011	431.12	433.78	434.70	433.33	433.32	431.95	428.23
2006	44.60	44.23	43.889	431.05	433.74	434.56	433.23	433.24	431.87	428.19
2007	44.51	44.14	43.776	430.99	433.70	434.43	433.13	433.17	431.80	428.16
2008	44.43	44.06	43.670	430.93	433.66	434.30	433.04	433.09	431.73	428.12
2009	44.35	43.99	43.571	430.88	433.63	434.17	432.95	433.02	431.66	428.09
2010	44.27	43.91	43.478	430.82	433.59	434.05	432.86	432.95	431.60	428.06
2011	44.20	43.84	43.391	430.77	433.56	433.94	432.77	432.88	431.53	428.03
2012	44.13	43.78	43.309	430.72	433.52	433.83	432.69	432.81	431.47	428.00
2013	44.06	43.71	43.232	430.67	433.49	433.73	432.61	432.74	431.41	427.97
2014	44.00	43.66	43.159	430.62	433.46	433.62	432.54	432.67	431.36	427.94
2015	43.94	43.60	43.091	430.58	433.42	433.53	432.46	432.61	431.30	427.91
2016	43.88	43.54	43.026	430.53	433.39	433.43	432.39	432.55	431.25	427.89
2017	43.82	43.49	42.965	430.49	433.36	433.34	432.32	432.48	431.19	427.86
2018	43.77	43.44	42.907	430.44	433.33	433.25	432.26	432.42	431.14	427.84
2019	43.72	43.39	42.852	430.40	433.30	433.17	432.19	432.36	431.09	427.81
2020	43.67	43.35	42.799	430.36	433.27	433.08	432.13	432.30	431.05	427.79
2021	43.62	43.30	42.750	430.32	433.24	433.00	432.07	432.24	431.00	427.77
2022	43.57	43.26	42.703	430.28	433.22	432.93	432.01	432.19	430.96	427.74
2023	43.53	43.22	42.658	430.25	433.19	432.85	431.95	432.13	430.91	427.72
2024	43.48	43.18	42.615	430.21	433.16	432.78	431.89	432.07	430.87	427.70
2025	43.44	43.14	42.574	430.18	433.13	432.71	431.84	432.02	430.83	427.68
2026	43.40	43.11	42.535	430.14	433.11	432.64	431.79	431.96	430.79	427.66
2027	43.37	43.07	42.498	430.11	433.08	432.57	431.73	431.91	430.75	427.64
2028	43.33	43.04	42.462	430.07	433.06	432.51	431.68	431.86	430.71	427.63
2029	43.29	43.01	42.428	430.04	433.03	432.44	431.63	431.81	430.67	427.61
2030	43.26	42.98	42.396	430.01	433.01	432.38	431.58	431.76	430.63	427.59
2031	43.22	42.95	42.364	429.98	432.98	432.32	431.54	431.71	430.60	427.57
2032	43.19	42.92	42.334	429.95	432.96	432.26	431.49	431.66	430.56	427.56
2033	43.16	42.89	42.305	429.92	432.93	432.21	431.45	431.61	430.53	427.54
2034	43.13	42.86	42.278	429.89	432.91	432.15	431.40	431.56	430.49	427.53
2035	43.10	42.83	42.251	429.86	432.89	432.10	431.36	431.52	430.46	427.51
2036	43.07	42.81	42.226	429.83	432.87	432.04	431.32	431.47	430.43	427.49
2037	43.04	42.78	42.201	429.81	432.84	431.99	431.28	431.43	430.39	427.48

Table C3: Land line Alt. - unit energy costs in 1993$/MWh for residential consumers

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	52.61	52.63	52.05	69.43	69.21	63.27	63.97	68.64	67.68	68.38
1997	52.52	52.55	51.97	59.19	59.13	57.23	57.49	58.97	58.69	58.90
1998	52.44	52.46	51.89	57.34	57.29	55.92	56.11	57.18	56.98	57.13
1999	52.36	52.38	51.82	56.28	56.24	55.15	55.30	56.15	56.00	56.11
2000	52.29	52.31	51.76	55.55	55.53	54.60	54.73	55.45	55.32	55.42
2001	52.22	52.24	51.69	55.01	54.99	54.18	54.29	54.92	54.81	54.89
2002	52.15	52.17	51.63	54.58	54.56	53.84	53.95	54.51	54.40	54.48
2003	52.09	52.10	51.58	54.23	54.21	53.56	53.66	54.16	54.07	54.14
2004	52.03	52.04	51.52	53.94	53.92	53.33	53.41	53.87	53.79	53.85
2005	51.97	51.98	51.47	53.69	53.67	53.12	53.20	53.63	53.55	53.61
2006	51.91	51.93	51.42	53.47	53.45	52.94	53.02	53.41	53.34	53.39
2007	51.86	51.87	51.37	53.27	53.26	52.78	52.85	53.22	53.15	53.20
2008	51.81	51.82	51.32	53.10	53.08	52.64	52.70	53.05	52.99	53.03
2009	51.76	51.77	51.28	52.94	52.93	52.51	52.57	52.90	52.84	52.88
2010	51.71	51.72	51.24	52.80	52.79	52.39	52.45	52.76	52.70	52.74
2011	51.66	51.68	51.20	52.67	52.66	52.28	52.33	52.63	52.58	52.62
2012	51.62	51.63	51.16	52.55	52.54	52.18	52.23	52.51	52.46	52.50
2013	51.58	51.59	51.12	52.44	52.43	52.09	52.14	52.40	52.36	52.39
2014	51.53	51.55	51.08	52.34	52.33	52.00	52.05	52.30	52.26	52.29
2015	51.49	51.51	51.05	52.24	52.24	51.92	51.96	52.21	52.17	52.20
2016	51.46	51.47	51.01	52.16	52.15	51.84	51.89	52.12	52.08	52.11
2017	51.42	51.43	50.98	52.07	52.06	51.77	51.81	52.04	52.00	52.03
2018	51.38	51.40	50.95	52.00	51.99	51.70	51.75	51.97	51.93	51.96
2019	51.35	51.36	50.92	51.92	51.91	51.64	51.68	51.89	51.86	51.88
2020	51.31	51.33	50.89	51.85	51.85	51.58	51.62	51.82	51.79	51.82
2021	51.28	51.30	50.86	51.79	51.78	51.52	51.56	51.76	51.73	51.75
2022	51.25	51.26	50.83	51.72	51.72	51.47	51.51	51.70	51.67	51.69
2023	51.22	51.23	50.80	51.67	51.66	51.42	51.45	51.64	51.61	51.63
2024	51.19	51.20	50.77	51.61	51.60	51.37	51.40	51.59	51.55	51.58
2025	51.16	51.17	50.75	51.56	51.55	51.32	51.36	51.53	51.50	51.52
2026	51.13	51.14	50.72	51.50	51.50	51.28	51.31	51.48	51.45	51.47
2027	51.10	51.12	50.70	51.46	51.45	51.23	51.27	51.43	51.40	51.43
2028	51.08	51.09	50.67	51.41	51.40	51.19	51.22	51.39	51.36	51.38
2029	51.05	51.06	50.65	51.36	51.36	51.15	51.18	51.34	51.31	51.33
2030	51.02	51.04	50.63	51.32	51.31	51.11	51.14	51.30	51.27	51.29
2031	51.00	51.01	50.61	51.28	51.27	51.08	51.11	51.26	51.23	51.25
2032	50.97	50.99	50.58	51.24	51.23	51.04	51.07	51.22	51.19	51.21
2033	50.95	50.96	50.56	51.20	51.19	51.01	51.04	51.18	51.16	51.17
2034	50.93	50.94	50.54	51.16	51.16	50.97	51.00	51.14	51.12	51.14
2035	50.90	50.92	50.52	51.13	51.12	50.94	50.97	51.11	51.08	51.10
2036	50.88	50.89	50.50	51.09	51.09	50.91	50.94	51.07	51.05	51.07
2037	50.86	50.87	50.48	51.06	51.05	50.88	50.91	51.04	51.02	51.03

Table C4: Land line Alt. - unit energy costs in 1993$/MWh for nonresidential consumer

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	45.86	45.46	45.68	57.70	65.99	73.63	67.13	65.65	61.10	49.34
1997	45.69	45.29	45.42	55.39	61.13	66.32	61.93	60.88	57.58	48.81
1998	45.54	45.14	45.19	53.86	57.60	61.36	58.19	57.41	55.33	48.34
1999	45.40	45.00	44.97	52.62	55.34	57.77	55.37	55.23	53.80	47.93
2000	45.26	44.87	44.78	51.60	53.81	55.43	53.18	53.73	52.57	47.56
2001	45.13	44.74	44.60	50.75	52.58	53.89	51.41	52.51	51.56	47.23
2002	45.02	44.63	44.44	50.02	51.57	52.64	49.97	51.51	50.72	46.93
2003	44.90	44.52	44.28	49.40	50.72	51.62	48.76	50.67	50.00	46.66
2004	44.80	44.41	44.14	48.86	50.00	50.76	47.74	49.96	49.38	46.41
2005	44.70	44.32	44.01	48.39	49.38	50.04	46.86	49.35	48.84	46.19
2006	44.60	44.23	43.89	47.97	48.84	49.41	46.10	48.81	48.37	45.98
2007	44.51	44.14	43.78	47.59	48.37	48.87	45.44	48.34	47.95	45.79
2008	44.43	44.06	43.67	47.26	47.95	48.40	44.85	47.93	47.58	45.61
2009	44.35	43.99	43.57	46.96	47.58	47.98	44.33	47.56	47.25	45.45
2010	44.27	43.91	43.48	46.68	47.25	47.60	43.86	47.23	46.95	45.30
2011	44.20	43.84	43.39	46.44	46.95	47.27	43.43	46.93	46.67	45.16
2012	44.13	43.78	43.31	46.21	46.68	46.96	43.05	46.66	46.43	45.03
2013	44.06	43.71	43.23	46.00	46.43	46.69	42.70	46.41	46.20	44.90
2014	44.00	43.66	43.16	45.81	46.20	46.44	42.39	46.19	45.99	44.79
2015	43.94	43.60	43.09	45.63	45.99	46.21	42.10	45.98	45.80	44.68
2016	43.88	43.54	43.03	45.47	45.80	46.00	41.83	45.79	45.62	44.57
2017	43.82	43.49	42.96	45.31	45.63	45.81	41.58	45.61	45.46	44.48
2018	43.77	43.44	42.91	45.17	45.46	45.63	41.35	45.45	45.31	44.39
2019	43.72	43.39	42.85	45.04	45.31	45.47	41.14	45.30	45.17	44.30
2020	43.67	43.35	42.80	44.91	45.17	45.32	40.94	45.16	45.03	44.22
2021	43.62	43.30	42.75	44.80	45.03	45.17	40.76	45.03	44.91	44.14
2022	43.57	43.26	42.70	44.69	44.91	45.04	40.58	44.90	44.79	44.07
2023	43.53	43.22	42.66	44.58	44.79	44.92	40.42	44.79	44.68	43.99
2024	43.48	43.18	42.61	44.49	44.68	44.80	40.27	44.68	44.58	43.93
2025	43.44	43.14	42.57	44.40	44.58	44.69	40.12	44.58	44.48	43.86
2026	43.40	43.11	42.54	44.31	44.48	44.59	39.99	44.48	44.39	43.80
2027	43.37	43.07	42.50	44.23	44.39	44.49	39.86	44.39	44.30	43.74
2028	43.33	43.04	42.46	44.15	44.31	44.40	39.74	44.30	44.22	43.69
2029	43.29	43.01	42.43	44.07	44.22	44.31	39.62	44.22	44.14	43.63
2030	43.26	42.98	42.40	44.00	44.14	44.23	39.52	44.14	44.07	43.58
2031	43.22	42.95	42.36	43.93	44.07	44.15	39.41	44.07	44.00	43.53
2032	43.19	42.92	42.33	43.87	44.00	44.07	39.31	44.00	43.93	43.49
2033	43.16	42.89	42.31	43.81	43.93	44.00	39.22	43.93	43.87	43.44
2034	43.13	42.86	42.28	43.75	43.87	43.94	39.13	43.86	43.81	43.40
2035	43.10	42.83	42.25	43.69	43.81	43.87	39.05	43.80	43.75	43.35
2036	43.07	42.81	42.23	43.64	43.75	43.81	38.96	43.74	43.69	43.31
2037	43.04	42.78	42.20	43.59	43.69	43.75	38.89	43.69	43.64	43.28

Table C5: Both Alternatives - unit energy costs for res. cons. in Cross Lake

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	29.214	2.100	27.114	1537.01	52.61
1997	29.769	2.100	27.669	1563.59	52.52
1998	30.312	2.100	28.212	1589.61	52.44
1999	30.845	2.100	28.745	1615.13	52.36
2000	31.367	2.100	29.267	1640.15	52.29
2001	31.880	2.100	29.780	1664.72	52.22
2002	32.384	2.100	30.284	1688.85	52.15
2003	32.879	2.100	30.779	1712.57	52.09
2004	33.367	2.100	31.267	1735.90	52.03
2005	33.846	2.100	31.746	1758.85	51.97
2006	34.318	2.100	32.218	1781.45	51.91
2007	34.783	2.100	32.683	1803.71	51.86
2008	35.241	2.100	33.141	1825.64	51.81
2009	35.692	2.100	33.592	1847.26	51.76
2010	36.137	2.100	34.037	1868.59	51.71
2011	36.577	2.100	34.477	1889.62	51.66
2012	37.010	2.100	34.910	1910.39	51.62
2013	37.438	2.100	35.338	1930.88	51.58
2014	37.861	2.100	35.761	1951.13	51.53
2015	38.278	2.100	36.178	1971.12	51.49
2016	38.691	2.100	36.591	1990.88	51.46
2017	39.099	2.100	36.999	2010.42	51.42
2018	39.502	2.100	37.402	2029.73	51.38
2019	39.901	2.100	37.801	2048.83	51.35
2020	40.295	2.100	38.195	2067.72	51.31
2021	40.686	2.100	38.586	2086.41	51.28
2022	41.072	2.100	38.972	2104.91	51.25
2023	41.454	2.100	39.354	2123.22	51.22
2024	41.833	2.100	39.733	2141.35	51.19
2025	42.208	2.100	40.108	2159.30	51.16
2026	42.579	2.100	40.479	2177.08	51.13
2027	42.947	2.100	40.847	2194.69	51.10
2028	43.311	2.100	41.211	2212.14	51.08
2029	43.672	2.100	41.572	2229.44	51.05
2030	44.030	2.100	41.930	2246.57	51.02
2031	44.385	2.100	42.285	2263.56	51.00
2032	44.737	2.100	42.637	2280.41	50.97
2033	45.085	2.100	42.985	2297.11	50.95
2034	45.431	2.100	43.331	2313.67	50.93
2035	45.774	2.100	43.674	2330.10	50.90
2036	46.114	2.100	44.014	2346.39	50.88
2037	46.452	2.100	44.352	2362.56	50.86

Table C6: Both Alternatives - unit energy costs for nonres. cons. in Cross Lake

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Third Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	107.492	13.080	20.000	74.412	4929.27	45.86
1997	111.392	13.080	20.000	78.312	5089.76	45.69
1998	115.292	13.080	20.000	82.212	5250.24	45.54
1999	119.192	13.080	20.000	86.112	5410.73	45.40
2000	123.092	13.080	20.000	90.012	5571.21	45.26
2001	126.992	13.080	20.000	93.912	5731.70	45.13
2002	130.892	13.080	20.000	97.812	5892.18	45.02
2003	134.792	13.080	20.000	101.712	6052.67	44.90
2004	138.692	13.080	20.000	105.612	6213.15	44.80
2005	142.592	13.080	20.000	109.512	6373.64	44.70
2006	146.492	13.080	20.000	113.412	6534.12	44.60
2007	150.392	13.080	20.000	117.312	6694.61	44.51
2008	154.292	13.080	20.000	121.212	6855.09	44.43
2009	158.192	13.080	20.000	125.112	7015.58	44.35
2010	162.092	13.080	20.000	129.012	7176.06	44.27
2011	165.992	13.080	20.000	132.912	7336.55	44.20
2012	169.892	13.080	20.000	136.812	7497.03	44.13
2013	173.792	13.080	20.000	140.712	7657.52	44.06
2014	177.692	13.080	20.000	144.612	7818.00	44.00
2015	181.592	13.080	20.000	148.512	7978.49	43.94
2016	185.492	13.080	20.000	152.412	8138.97	43.88
2017	189.392	13.080	20.000	156.312	8299.46	43.82
2018	193.292	13.080	20.000	160.212	8459.94	43.77
2019	197.192	13.080	20.000	164.112	8620.43	43.72
2020	201.092	13.080	20.000	168.012	8780.91	43.67
2021	204.992	13.080	20.000	171.912	8941.40	43.62
2022	208.892	13.080	20.000	175.812	9101.88	43.57
2023	212.792	13.080	20.000	179.712	9262.37	43.53
2024	216.692	13.080	20.000	183.612	9422.85	43.48
2025	220.592	13.080	20.000	187.512	9583.34	43.44
2026	224.492	13.080	20.000	191.412	9743.82	43.40
2027	228.392	13.080	20.000	195.312	9904.31	43.37
2028	232.292	13.080	20.000	199.212	10064.79	43.33
2029	236.192	13.080	20.000	203.112	10225.28	43.29
2030	240.092	13.080	20.000	207.012	10385.76	43.26
2031	243.992	13.080	20.000	210.912	10546.25	43.22
2032	247.892	13.080	20.000	214.812	10706.73	43.19
2033	251.792	13.080	20.000	218.712	10867.22	43.16
2034	255.692	13.080	20.000	222.612	11027.70	43.13
2035	259.592	13.080	20.000	226.512	11188.19	43.10
2036	263.492	13.080	20.000	230.412	11348.67	43.07
2037	267.392	13.080	20.000	234.312	11509.16	43.04

Table C7: Both Alts. - unit energy costs for res. cons. in Nelson House

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	29.085	2.100	26.985	1530.84	52.63
1997	29.638	2.100	27.538	1557.31	52.55
1998	30.179	2.100	28.079	1583.24	52.46
1999	30.710	2.100	28.610	1608.66	52.38
2000	31.230	2.100	29.130	1633.59	52.31
2001	31.741	2.100	29.641	1658.07	52.24
2002	32.243	2.100	30.143	1682.11	52.17
2003	32.737	2.100	30.637	1705.74	52.10
2004	33.222	2.100	31.122	1728.98	52.04
2005	33.700	2.100	31.600	1751.85	51.98
2006	34.170	2.100	32.070	1774.37	51.93
2007	34.633	2.100	32.533	1796.54	51.87
2008	35.089	2.100	32.989	1818.39	51.82
2009	35.539	2.100	33.439	1839.93	51.77
2010	35.983	2.100	33.883	1861.18	51.72
2011	36.420	2.100	34.320	1882.14	51.68
2012	36.852	2.100	34.752	1902.82	51.63
2013	37.279	2.100	35.179	1923.24	51.59
2014	37.700	2.100	35.600	1943.41	51.55
2015	38.116	2.100	36.016	1963.34	51.51
2016	38.527	2.100	36.427	1983.02	51.47
2017	38.933	2.100	36.833	2002.48	51.43
2018	39.335	2.100	37.235	2021.72	51.40
2019	39.732	2.100	37.632	2040.75	51.36
2020	40.125	2.100	38.025	2059.57	51.33
2021	40.514	2.100	38.414	2078.20	51.30
2022	40.899	2.100	38.799	2096.63	51.26
2023	41.280	2.100	39.180	2114.87	51.23
2024	41.657	2.100	39.557	2132.93	51.20
2025	42.031	2.100	39.931	2150.81	51.17
2026	42.400	2.100	40.300	2168.53	51.14
2027	42.767	2.100	40.667	2186.07	51.12
2028	43.130	2.100	41.030	2203.46	51.09
2029	43.490	2.100	41.390	2220.69	51.06
2030	43.846	2.100	41.746	2237.76	51.04
2031	44.200	2.100	42.100	2254.69	51.01
2032	44.550	2.100	42.450	2271.47	50.99
2033	44.897	2.100	42.797	2288.11	50.96
2034	45.242	2.100	43.142	2304.61	50.94
2035	45.584	2.100	43.484	2320.97	50.92
2036	45.923	2.100	43.823	2337.21	50.89
2037	46.259	2.100	44.159	2353.32	50.87

Table C8: Both Alts. - unit energy costs for nonres. cons. in Nel. House

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Third Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	117.371	13.080	20.000	84.291	5335.79	45.46
1997	122.071	13.080	20.000	88.991	5529.20	45.29
1998	126.771	13.080	20.000	93.691	5722.60	45.14
1999	131.471	13.080	20.000	98.391	5916.01	45.00
2000	136.171	13.080	20.000	103.091	6109.41	44.87
2001	140.871	13.080	20.000	107.791	6302.82	44.74
2002	145.571	13.080	20.000	112.491	6496.22	44.63
2003	150.271	13.080	20.000	117.191	6689.63	44.52
2004	154.971	13.080	20.000	121.891	6883.03	44.41
2005	159.671	13.080	20.000	126.591	7076.44	44.32
2006	164.371	13.080	20.000	131.291	7269.84	44.23
2007	169.071	13.080	20.000	135.991	7463.25	44.14
2008	173.771	13.080	20.000	140.691	7656.65	44.06
2009	178.471	13.080	20.000	145.391	7850.06	43.99
2010	183.171	13.080	20.000	150.091	8043.46	43.91
2011	187.871	13.080	20.000	154.791	8236.87	43.84
2012	192.571	13.080	20.000	159.491	8430.27	43.78
2013	197.271	13.080	20.000	164.191	8623.68	43.71
2014	201.971	13.080	20.000	168.891	8817.08	43.66
2015	206.671	13.080	20.000	173.591	9010.49	43.60
2016	211.371	13.080	20.000	178.291	9203.89	43.54
2017	216.071	13.080	20.000	182.991	9397.30	43.49
2018	220.771	13.080	20.000	187.691	9590.70	43.44
2019	225.471	13.080	20.000	192.391	9784.11	43.39
2020	230.171	13.080	20.000	197.091	9977.51	43.35
2021	234.871	13.080	20.000	201.791	10170.92	43.30
2022	239.571	13.080	20.000	206.491	10364.32	43.26
2023	244.271	13.080	20.000	211.191	10557.73	43.22
2024	248.971	13.080	20.000	215.891	10751.13	43.18
2025	253.671	13.080	20.000	220.591	10944.54	43.14
2026	258.371	13.080	20.000	225.291	11137.94	43.11
2027	263.071	13.080	20.000	229.991	11331.35	43.07
2028	267.771	13.080	20.000	234.691	11524.75	43.04
2029	272.471	13.080	20.000	239.391	11718.16	43.01
2030	277.171	13.080	20.000	244.091	11911.56	42.98
2031	281.871	13.080	20.000	248.791	12104.97	42.95
2032	286.571	13.080	20.000	253.491	12298.37	42.92
2033	291.271	13.080	20.000	258.191	12491.78	42.89
2034	295.971	13.080	20.000	262.891	12685.18	42.86
2035	300.671	13.080	20.000	267.591	12878.59	42.83
2036	305.371	13.080	20.000	272.291	13071.99	42.81
2037	310.071	13.080	20.000	276.991	13265.40	42.78

Table C9: Both Alts. - unit energy costs for res. cons. in Split Lake

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	33.175	2.100	31.075	1726.72	52.05
1997	33.820	2.100	31.720	1757.59	51.97
1998	34.451	2.100	32.351	1787.83	51.89
1999	35.070	2.100	32.970	1817.47	51.82
2000	35.677	2.100	33.577	1846.54	51.76
2001	36.273	2.100	34.173	1875.08	51.69
2002	36.858	2.100	34.758	1903.12	51.63
2003	37.434	2.100	35.334	1930.67	51.58
2004	38.000	2.100	35.900	1957.77	51.52
2005	38.556	2.100	36.456	1984.44	51.47
2006	39.105	2.100	37.005	2010.69	51.42
2007	39.644	2.100	37.544	2036.54	51.37
2008	40.176	2.100	38.076	2062.02	51.32
2009	40.701	2.100	38.601	2087.14	51.28
2010	41.218	2.100	39.118	2111.91	51.24
2011	41.729	2.100	39.629	2136.35	51.20
2012	42.232	2.100	40.132	2160.47	51.16
2013	42.729	2.100	40.629	2184.29	51.12
2014	43.221	2.100	41.121	2207.80	51.08
2015	43.706	2.100	41.606	2231.03	51.05
2016	44.185	2.100	42.085	2253.99	51.01
2017	44.659	2.100	42.559	2276.68	50.98
2018	45.127	2.100	43.027	2299.12	50.95
2019	45.591	2.100	43.491	2321.30	50.92
2020	46.049	2.100	43.949	2343.25	50.89
2021	46.502	2.100	44.402	2364.97	50.86
2022	46.951	2.100	44.851	2386.46	50.83
2023	47.395	2.100	45.295	2407.73	50.80
2024	47.835	2.100	45.735	2428.79	50.77
2025	48.270	2.100	46.170	2449.64	50.75
2026	48.702	2.100	46.602	2470.30	50.72
2027	49.129	2.100	47.029	2490.76	50.70
2028	49.552	2.100	47.452	2511.03	50.67
2029	49.972	2.100	47.872	2531.12	50.65
2030	50.387	2.100	48.287	2551.03	50.63
2031	50.800	2.100	48.700	2570.76	50.61
2032	51.208	2.100	49.108	2590.33	50.58
2033	51.613	2.100	49.513	2609.73	50.56
2034	52.015	2.100	49.915	2628.97	50.54
2035	52.414	2.100	50.314	2648.06	50.52
2036	52.809	2.100	50.709	2666.99	50.50
2037	53.201	2.100	51.101	2685.77	50.48

Table C10: Both Alts. - unit energy costs for nonresidential consumers in Split Lake

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Third Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	111.797	13.080	20.000	78.717	5106.41	45.68
1997	118.486	13.080	20.000	85.406	5381.69	45.42
1998	125.317	13.080	20.000	92.237	5662.77	45.19
1999	132.286	13.080	20.000	99.206	5949.52	44.97
2000	139.389	13.080	20.000	106.309	6241.85	44.78
2001	146.626	13.080	20.000	113.546	6539.64	44.60
2002	153.993	13.080	20.000	120.913	6842.79	44.44
2003	161.488	13.080	20.000	128.408	7151.22	44.28
2004	169.110	13.080	20.000	136.030	7464.84	44.14
2005	176.855	13.080	20.000	143.775	7783.55	44.01
2006	184.722	13.080	20.000	151.642	8107.28	43.89
2007	192.709	13.080	20.000	159.629	8435.96	43.78
2008	200.815	13.080	20.000	167.735	8769.50	43.67
2009	209.037	13.080	20.000	175.957	9107.85	43.57
2010	217.374	13.080	20.000	184.294	9450.92	43.48
2011	225.825	13.080	20.000	192.745	9798.67	43.39
2012	234.388	13.080	20.000	201.308	10151.02	43.31
2013	243.061	13.080	20.000	209.981	10507.92	43.23
2014	251.843	13.080	20.000	218.763	10869.31	43.16
2015	260.733	13.080	20.000	227.653	11235.13	43.09
2016	269.729	13.080	20.000	236.649	11605.33	43.03
2017	278.831	13.080	20.000	245.751	11979.87	42.96
2018	288.037	13.080	20.000	254.957	12358.68	42.91
2019	297.345	13.080	20.000	264.265	12741.73	42.85
2020	306.756	13.080	20.000	273.676	13128.96	42.80
2021	316.266	13.080	20.000	283.186	13520.34	42.75
2022	325.877	13.080	20.000	292.797	13915.81	42.70
2023	335.586	13.080	20.000	302.506	14315.34	42.66
2024	345.393	13.080	20.000	312.313	14718.89	42.61
2025	355.296	13.080	20.000	322.216	15126.41	42.57
2026	365.295	13.080	20.000	332.215	15537.87	42.54
2027	375.389	13.080	20.000	342.309	15953.23	42.50
2028	385.577	13.080	20.000	352.497	16372.45	42.46
2029	395.857	13.080	20.000	362.777	16795.51	42.43
2030	406.230	13.080	20.000	373.150	17222.35	42.40
2031	416.695	13.080	20.000	383.615	17652.96	42.36
2032	427.250	13.080	20.000	394.170	18087.30	42.33
2033	437.894	13.080	20.000	404.814	18525.33	42.31
2034	448.628	13.080	20.000	415.548	18967.03	42.28
2035	459.450	13.080	20.000	426.370	19412.36	42.25
2036	470.360	13.080	20.000	437.280	19861.30	42.23
2037	481.357	13.080	20.000	448.277	20313.81	42.20

Table C11: Diesel Alt. - unit energy costs for res. cons.in Oxford House

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	6.405	2.100	4.305	544.49	85.01
1997	6.545	2.100	4.445	551.24	84.22
1998	6.685	2.100	4.585	557.98	83.47
1999	6.825	2.100	4.725	564.73	82.74
2000	6.965	2.100	4.865	571.48	82.05
2001	7.105	2.100	5.005	578.23	81.38
2002	7.245	2.100	5.145	584.98	80.74
2003	7.385	2.100	5.285	591.73	80.13
2004	7.525	2.100	5.425	598.48	79.53
2005	7.665	2.100	5.565	605.23	78.96
2006	7.805	2.100	5.705	611.98	78.41
2007	7.945	2.100	5.845	618.73	77.88
2008	8.085	2.100	5.985	625.48	77.36
2009	8.225	2.100	6.125	632.23	76.87
2010	8.365	2.100	6.265	638.98	76.39
2011	8.505	2.100	6.405	645.73	75.92
2012	8.645	2.100	6.545	652.48	75.47
2013	8.785	2.100	6.685	659.23	75.04
2014	8.925	2.100	6.825	665.98	74.62
2015	9.065	2.100	6.965	672.72	74.21
2016	9.205	2.100	7.105	679.47	73.82
2017	9.345	2.100	7.245	686.22	73.43
2018	9.485	2.100	7.385	692.97	73.06
2019	9.625	2.100	7.525	699.72	72.70
2020	9.765	2.100	7.665	706.47	72.35
2021	9.905	2.100	7.805	713.22	72.01
2022	10.045	2.100	7.945	719.97	71.67
2023	10.185	2.100	8.085	726.72	71.35
2024	10.325	2.100	8.225	733.47	71.04
2025	10.465	2.100	8.365	740.22	70.73
2026	10.605	2.100	8.505	746.97	70.44
2027	10.745	2.100	8.645	753.72	70.15
2028	10.885	2.100	8.785	760.47	69.86
2029	11.025	2.100	8.925	767.22	69.59
2030	11.165	2.100	9.065	773.97	69.32
2031	11.305	2.100	9.205	780.72	69.06
2032	11.445	2.100	9.345	787.46	68.80
2033	11.585	2.100	9.485	794.21	68.56
2034	11.725	2.100	9.625	800.96	68.31
2035	11.865	2.100	9.765	807.71	68.08
2036	12.005	2.100	9.905	814.46	67.84
2037	12.145	2.100	10.045	821.21	67.62

Table C12: Diesel Alt. - unit energy costs for nonres. cons. in Ox. House

YEAR	Average Annual Demand (MWh/meter)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	31.222	13482.38	431.82
1997	31.686	13679.86	431.73
1998	32.141	13873.27	431.64
1999	32.587	14062.84	431.55
2000	33.024	14248.81	431.47
2001	33.453	14431.36	431.40
2002	33.874	14610.68	431.32
2003	34.289	14786.93	431.25
2004	34.696	14960.27	431.18
2005	35.097	15130.83	431.12
2006	35.492	15298.75	431.05
2007	35.880	15464.15	430.99
2008	36.263	15627.13	430.93
2009	36.641	15787.79	430.88
2010	37.013	15946.24	430.82
2011	37.381	16102.57	430.77
2012	37.743	16256.85	430.72
2013	38.101	16409.16	430.67
2014	38.455	16559.58	430.62
2015	38.804	16708.18	430.58
2016	39.149	16855.02	430.53
2017	39.491	17000.17	430.49
2018	39.828	17143.67	430.44
2019	40.161	17285.58	430.40
2020	40.491	17425.97	430.36
2021	40.818	17564.86	430.32
2022	41.141	17702.32	430.28
2023	41.461	17838.38	430.25
2024	41.777	17973.09	430.21
2025	42.091	18106.48	430.18
2026	42.401	18238.60	430.14
2027	42.709	18369.47	430.11
2028	43.014	18499.14	430.07
2029	43.316	18627.64	430.04
2030	43.615	18754.99	430.01
2031	43.912	18881.23	429.98
2032	44.206	19006.39	429.95
2033	44.498	19130.49	429.92
2034	44.787	19253.56	429.89
2035	45.074	19375.63	429.86
2036	45.359	19496.71	429.83
2037	45.641	19616.84	429.81

Table C13: Land line alt. - unit energy costs for res. cons. in Oxford House

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	6.405	2.100	4.305	444.71	69.43
1997	12.205	2.100	10.105	722.47	59.19
1998	14.607	2.100	12.507	837.52	57.34
1999	16.451	2.100	14.351	925.81	56.28
2000	18.005	2.100	15.905	1000.23	55.55
2001	19.374	2.100	17.274	1065.80	55.01
2002	20.612	2.100	18.512	1125.08	54.58
2003	21.750	2.100	19.650	1179.60	54.23
2004	22.810	2.100	20.710	1230.34	53.94
2005	23.805	2.100	21.705	1277.99	53.69
2006	24.746	2.100	22.646	1323.07	53.47
2007	25.641	2.100	23.541	1365.94	53.27
2008	26.497	2.100	24.397	1406.90	53.10
2009	27.317	2.100	25.217	1446.19	52.94
2010	28.107	2.100	26.007	1484.00	52.80
2011	28.868	2.100	26.768	1520.48	52.67
2012	29.605	2.100	27.505	1555.76	52.55
2013	30.319	2.100	28.219	1589.95	52.44
2014	31.012	2.100	28.912	1623.15	52.34
2015	31.687	2.100	29.587	1655.44	52.24
2016	32.343	2.100	30.243	1686.90	52.16
2017	32.984	2.100	30.884	1717.57	52.07
2018	33.609	2.100	31.509	1747.53	52.00
2019	34.221	2.100	32.121	1776.81	51.92
2020	34.819	2.100	32.719	1805.46	51.85
2021	35.405	2.100	33.305	1833.52	51.79
2022	35.979	2.100	33.879	1861.02	51.72
2023	36.543	2.100	34.443	1888.00	51.67
2024	37.096	2.100	34.996	1914.49	51.61
2025	37.639	2.100	35.539	1940.50	51.56
2026	38.173	2.100	36.073	1966.07	51.50
2027	38.698	2.100	36.598	1991.22	51.46
2028	39.215	2.100	37.115	2015.97	51.41
2029	39.723	2.100	37.623	2040.33	51.36
2030	40.225	2.100	38.125	2064.32	51.32
2031	40.718	2.100	38.618	2087.97	51.28
2032	41.205	2.100	39.105	2111.28	51.24
2033	41.685	2.100	39.585	2134.27	51.20
2034	42.159	2.100	40.059	2156.95	51.16
2035	42.626	2.100	40.526	2179.33	51.13
2036	43.087	2.100	40.987	2201.43	51.09
2037	43.543	2.100	41.443	2223.25	51.06

Table C14: Land line alt. - unit energy costs for nonres. cons.in Oxford House

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Third Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	31.222	13.080	18.142	0.000	1801.51	57.70
1997	35.522	13.080	20.000	2.442	1967.71	55.39
1998	39.822	13.080	20.000	6.742	2144.66	53.86
1999	44.122	13.080	20.000	11.042	2321.60	52.62
2000	48.422	13.080	20.000	15.342	2498.55	51.60
2001	52.722	13.080	20.000	19.642	2675.49	50.75
2002	57.022	13.080	20.000	23.942	2852.44	50.02
2003	61.322	13.080	20.000	28.242	3029.38	49.40
2004	65.622	13.080	20.000	32.542	3206.33	48.86
2005	69.922	13.080	20.000	36.842	3383.27	48.39
2006	74.222	13.080	20.000	41.142	3560.22	47.97
2007	78.522	13.080	20.000	45.442	3737.16	47.59
2008	82.822	13.080	20.000	49.742	3914.11	47.26
2009	87.122	13.080	20.000	54.042	4091.05	46.96
2010	91.422	13.080	20.000	58.342	4268.00	46.68
2011	95.722	13.080	20.000	62.642	4444.94	46.44
2012	100.022	13.080	20.000	66.942	4621.89	46.21
2013	104.322	13.080	20.000	71.242	4798.83	46.00
2014	108.622	13.080	20.000	75.542	4975.78	45.81
2015	112.922	13.080	20.000	79.842	5152.72	45.63
2016	117.222	13.080	20.000	84.142	5329.67	45.47
2017	121.522	13.080	20.000	88.442	5506.61	45.31
2018	125.822	13.080	20.000	92.742	5683.56	45.17
2019	130.122	13.080	20.000	97.042	5860.50	45.04
2020	134.422	13.080	20.000	101.342	6037.45	44.91
2021	138.722	13.080	20.000	105.642	6214.39	44.80
2022	143.022	13.080	20.000	109.942	6391.34	44.69
2023	147.322	13.080	20.000	114.242	6568.28	44.58
2024	151.622	13.080	20.000	118.542	6745.23	44.49
2025	155.922	13.080	20.000	122.842	6922.17	44.40
2026	160.222	13.080	20.000	127.142	7099.12	44.31
2027	164.522	13.080	20.000	131.442	7276.06	44.23
2028	168.822	13.080	20.000	135.742	7453.01	44.15
2029	173.122	13.080	20.000	140.042	7629.95	44.07
2030	177.422	13.080	20.000	144.342	7806.90	44.00
2031	181.722	13.080	20.000	148.642	7983.84	43.93
2032	186.022	13.080	20.000	152.942	8160.79	43.87
2033	190.322	13.080	20.000	157.242	8337.73	43.81
2034	194.622	13.080	20.000	161.542	8514.68	43.75
2035	198.922	13.080	20.000	165.842	8691.62	43.69
2036	203.222	13.080	20.000	170.142	8868.57	43.64
2037	207.522	13.080	20.000	174.442	9045.51	43.59

Table C15: Diesel Alt. - unit energy costs for residential consumers in Gods Lake

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cos (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	6.470	2.100	4.370	547.62	84.64
1997	6.600	2.100	4.500	553.89	83.92
1998	6.730	2.100	4.630	560.15	83.23
1999	6.860	2.100	4.760	566.42	82.57
2000	6.990	2.100	4.890	572.69	81.93
2001	7.120	2.100	5.020	578.96	81.31
2002	7.250	2.100	5.150	585.22	80.72
2003	7.380	2.100	5.280	591.49	80.15
2004	7.510	2.100	5.410	597.76	79.59
2005	7.640	2.100	5.540	604.03	79.06
2006	7.770	2.100	5.670	610.29	78.54
2007	7.900	2.100	5.800	616.56	78.05
2008	8.030	2.100	5.930	622.83	77.56
2009	8.160	2.100	6.060	629.09	77.09
2010	8.290	2.100	6.190	635.36	76.64
2011	8.420	2.100	6.320	641.63	76.20
2012	8.550	2.100	6.450	647.90	75.78
2013	8.680	2.100	6.580	654.16	75.36
2014	8.810	2.100	6.710	660.43	74.96
2015	8.940	2.100	6.840	666.70	74.57
2016	9.070	2.100	6.970	672.97	74.20
2017	9.200	2.100	7.100	679.23	73.83
2018	9.330	2.100	7.230	685.50	73.47
2019	9.460	2.100	7.360	691.77	73.13
2020	9.590	2.100	7.490	698.03	72.79
2021	9.720	2.100	7.620	704.30	72.46
2022	9.850	2.100	7.750	710.57	72.14
2023	9.980	2.100	7.880	716.84	71.83
2024	10.110	2.100	8.010	723.10	71.52
2025	10.240	2.100	8.140	729.37	71.23
2026	10.370	2.100	8.270	735.64	70.94
2027	10.500	2.100	8.400	741.91	70.66
2028	10.630	2.100	8.530	748.17	70.38
2029	10.760	2.100	8.660	754.44	70.12
2030	10.890	2.100	8.790	760.71	69.85
2031	11.020	2.100	8.920	766.98	69.60
2032	11.150	2.100	9.050	773.24	69.35
2033	11.280	2.100	9.180	779.51	69.11
2034	11.410	2.100	9.310	785.78	68.87
2035	11.540	2.100	9.440	792.04	68.63
2036	11.670	2.100	9.570	798.31	68.41
2037	11.800	2.100	9.700	804.58	68.18

Table C16: Diesel Alt. - unit energy costs for nonresidential consumers in Gods La

YEAR	**Average Annual Demand** (MWh/meter)	**Average Annual Cost** (1993$/meter)	**Average Annual Unit Energy Cost** (1993$/MWh/meter)
1996	22.767	9884.94	434.19
1997	22.900	9941.55	434.13
1998	23.030	9996.99	434.09
1999	23.158	10051.34	434.04
2000	23.283	10104.65	433.99
2001	23.406	10156.98	433.95
2002	23.527	10208.38	433.90
2003	23.646	10258.91	433.86
2004	23.762	10308.60	433.82
2005	23.877	10357.50	433.78
2006	23.990	10405.63	433.74
2007	24.102	10453.05	433.70
2008	24.212	10499.77	433.66
2009	24.320	10545.82	433.63
2010	24.427	10591.25	433.59
2011	24.532	10636.06	433.56
2012	24.636	10680.29	433.52
2013	24.739	10723.95	433.49
2014	24.840	10767.07	433.46
2015	24.940	10809.67	433.42
2016	25.039	10851.76	433.39
2017	25.137	10893.37	433.36
2018	25.234	10934.51	433.33
2019	25.329	10975.19	433.30
2020	25.424	11015.43	433.27
2021	25.517	11055.25	433.24
2022	25.610	11094.65	433.22
2023	25.702	11133.66	433.19
2024	25.792	11172.27	433.16
2025	25.882	11210.51	433.13
2026	25.971	11248.39	433.11
2027	26.060	11285.91	433.08
2028	26.147	11323.08	433.06
2029	26.233	11359.91	433.03
2030	26.319	11396.42	433.01
2031	26.404	11432.61	432.98
2032	26.489	11468.49	432.96
2033	26.572	11504.06	432.93
2034	26.655	11539.34	432.91
2035	26.737	11574.34	432.89
2036	26.819	11609.05	432.87
2037	26.900	11643.49	432.84

Table C17: Land line Alt. - unit energy costs for residential consumers in Gods Lak

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cos (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	6.470	2.100	4.370	447.82	69.21
1997	12.270	2.100	10.170	725.58	59.13
1998	14.672	2.100	12.572	840.64	57.29
1999	16.516	2.100	14.416	928.92	56.24
2000	18.070	2.100	15.970	1003.34	55.53
2001	19.439	2.100	17.339	1068.92	54.99
2002	20.677	2.100	18.577	1128.20	54.56
2003	21.815	2.100	19.715	1182.71	54.21
2004	22.875	2.100	20.775	1233.45	53.92
2005	23.870	2.100	21.770	1281.11	53.67
2006	24.811	2.100	22.711	1326.18	53.45
2007	25.706	2.100	23.606	1369.05	53.26
2008	26.562	2.100	24.462	1410.02	53.08
2009	27.382	2.100	25.282	1449.31	52.93
2010	28.172	2.100	26.072	1487.11	52.79
2011	28.933	2.100	26.833	1523.59	52.66
2012	29.670	2.100	27.570	1558.87	52.54
2013	30.384	2.100	28.284	1593.06	52.43
2014	31.077	2.100	28.977	1626.26	52.33
2015	31.752	2.100	29.652	1658.56	52.24
2016	32.408	2.100	30.308	1690.01	52.15
2017	33.049	2.100	30.949	1720.69	52.06
2018	33.674	2.100	31.574	1750.64	51.99
2019	34.286	2.100	32.186	1779.92	51.91
2020	34.884	2.100	32.784	1808.57	51.85
2021	35.470	2.100	33.370	1836.63	51.78
2022	36.044	2.100	33.944	1864.13	51.72
2023	36.608	2.100	34.508	1891.11	51.66
2024	37.161	2.100	35.061	1917.60	51.60
2025	37.704	2.100	35.604	1943.61	51.55
2026	38.238	2.100	36.138	1969.19	51.50
2027	38.763	2.100	36.663	1994.33	51.45
2028	39.280	2.100	37.180	2019.08	51.40
2029	39.788	2.100	37.688	2043.44	51.36
2030	40.290	2.100	38.190	2067.44	51.31
2031	40.783	2.100	38.683	2091.08	51.27
2032	41.270	2.100	39.170	2114.39	51.23
2033	41.750	2.100	39.650	2137.38	51.19
2034	42.224	2.100	40.124	2160.06	51.16
2035	42.691	2.100	40.591	2182.44	51.12
2036	43.152	2.100	41.052	2204.54	51.09
2037	43.608	2.100	41.508	2226.36	51.05

Table C18: Land line Alt. - unit energy costs for nonresidential consumers in Gods Lak

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Third Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	22.767	13.080	9.687	0.000	1502.43	65.99
1997	27.067	13.080	13.987	0.000	1654.52	61.13
1998	31.367	13.080	18.287	0.000	1806.61	57.60
1999	35.667	13.080	20.000	2.587	1973.66	55.34
2000	39.967	13.080	20.000	6.887	2150.60	53.81
2001	44.267	13.080	20.000	11.187	2327.55	52.58
2002	48.567	13.080	20.000	15.487	2504.49	51.57
2003	52.867	13.080	20.000	19.787	2681.44	50.72
2004	57.167	13.080	20.000	24.087	2858.38	50.00
2005	61.467	13.080	20.000	28.387	3035.33	49.38
2006	65.767	13.080	20.000	32.687	3212.27	48.84
2007	70.067	13.080	20.000	36.987	3389.22	48.37
2008	74.367	13.080	20.000	41.287	3566.16	47.95
2009	78.667	13.080	20.000	45.587	3743.11	47.58
2010	82.967	13.080	20.000	49.887	3920.05	47.25
2011	87.267	13.080	20.000	54.187	4097.00	46.95
2012	91.567	13.080	20.000	58.487	4273.94	46.68
2013	95.867	13.080	20.000	62.787	4450.89	46.43
2014	100.167	13.080	20.000	67.087	4627.83	46.20
2015	104.467	13.080	20.000	71.387	4804.78	45.99
2016	108.767	13.080	20.000	75.687	4981.72	45.80
2017	113.067	13.080	20.000	79.987	5158.67	45.63
2018	117.367	13.080	20.000	84.287	5335.61	45.46
2019	121.667	13.080	20.000	88.587	5512.56	45.31
2020	125.967	13.080	20.000	92.887	5689.50	45.17
2021	130.267	13.080	20.000	97.187	5866.45	45.03
2022	134.567	13.080	20.000	101.487	6043.39	44.91
2023	138.867	13.080	20.000	105.787	6220.34	44.79
2024	143.167	13.080	20.000	110.087	6397.28	44.68
2025	147.467	13.080	20.000	114.387	6574.23	44.58
2026	151.767	13.080	20.000	118.687	6751.17	44.48
2027	156.067	13.080	20.000	122.987	6928.12	44.39
2028	160.367	13.080	20.000	127.287	7105.06	44.31
2029	164.667	13.080	20.000	131.587	7282.01	44.22
2030	168.967	13.080	20.000	135.887	7458.95	44.14
2031	173.267	13.080	20.000	140.187	7635.90	44.07
2032	177.567	13.080	20.000	144.487	7812.84	44.00
2033	181.867	13.080	20.000	148.787	7989.79	43.93
2034	186.167	13.080	20.000	153.087	8166.73	43.87
2035	190.467	13.080	20.000	157.387	8343.68	43.81
2036	194.767	13.080	20.000	161.687	8520.62	43.75
2037	199.067	13.080	20.000	165.987	8697.57	43.69

Table C19: Diesel Alt. - unit energy costs for residential consumers in Gods River

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	8.970	2.100	6.870	668.14	74.49
1997	9.360	2.100	7.260	686.95	73.39
1998	9.750	2.100	7.650	705.75	72.38
1999	10.140	2.100	8.040	724.55	71.45
2000	10.530	2.100	8.430	743.35	70.59
2001	10.920	2.100	8.820	762.15	69.79
2002	11.310	2.100	9.210	780.96	69.05
2003	11.700	2.100	9.600	799.76	68.36
2004	12.090	2.100	9.990	818.56	67.71
2005	12.480	2.100	10.380	837.36	67.10
2006	12.870	2.100	10.770	856.16	66.52
2007	13.260	2.100	11.160	874.97	65.99
2008	13.650	2.100	11.550	893.77	65.48
2009	14.040	2.100	11.940	912.57	65.00
2010	14.430	2.100	12.330	931.37	64.54
2011	14.820	2.100	12.720	950.17	64.11
2012	15.210	2.100	13.110	968.98	63.71
2013	15.600	2.100	13.500	987.78	63.32
2014	15.990	2.100	13.890	1006.58	62.95
2015	16.380	2.100	14.280	1025.38	62.60
2016	16.770	2.100	14.670	1044.18	62.26
2017	17.160	2.100	15.060	1062.98	61.95
2018	17.550	2.100	15.450	1081.79	61.64
2019	17.940	2.100	15.840	1100.59	61.35
2020	18.330	2.100	16.230	1119.39	61.07
2021	18.720	2.100	16.620	1138.19	60.80
2022	19.110	2.100	17.010	1156.99	60.54
2023	19.500	2.100	17.400	1175.80	60.30
2024	19.890	2.100	17.790	1194.60	60.06
2025	20.280	2.100	18.180	1213.40	59.83
2026	20.670	2.100	18.570	1232.20	59.61
2027	21.060	2.100	18.960	1251.00	59.40
2028	21.450	2.100	19.350	1269.81	59.20
2029	21.840	2.100	19.740	1288.61	59.00
2030	22.230	2.100	20.130	1307.41	58.81
2031	22.620	2.100	20.520	1326.21	58.63
2032	23.010	2.100	20.910	1345.01	58.45
2033	23.400	2.100	21.300	1363.82	58.28
2034	23.790	2.100	21.690	1382.62	58.12
2035	24.180	2.100	22.080	1401.42	57.96
2036	24.570	2.100	22.470	1420.22	57.80
2037	24.960	2.100	22.860	1439.02	57.65

Table C20: Diesel Alt. - unit energy costs for nonresidential consumers in Gods River

YEAR	Average Annual Demand (MWh/meter)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	18.224	7952.35	436.36
1997	18.616	8119.11	436.13
1998	19.000	8282.43	435.92
1999	19.376	8442.52	435.71
2000	19.745	8599.55	435.52
2001	20.108	8753.71	435.34
2002	20.464	8905.13	435.17
2003	20.813	9053.97	435.01
2004	21.158	9200.34	434.85
2005	21.496	9344.37	434.70
2006	21.829	9486.17	434.56
2007	22.158	9625.84	434.43
2008	22.481	9763.47	434.30
2009	22.800	9899.14	434.17
2010	23.114	10032.94	434.05
2011	23.425	10164.95	433.94
2012	23.731	10295.23	433.83
2013	24.033	10423.85	433.73
2014	24.332	10550.87	433.62
2015	24.627	10676.36	433.53
2016	24.918	10800.36	433.43
2017	25.206	10922.92	433.34
2018	25.491	11044.10	433.25
2019	25.773	11163.94	433.17
2020	26.051	11282.49	433.08
2021	26.327	11399.78	433.00
2022	26.600	11515.85	432.93
2023	26.870	11630.75	432.85
2024	27.137	11744.50	432.78
2025	27.402	11857.14	432.71
2026	27.664	11968.71	432.64
2027	27.924	12079.22	432.57
2028	28.182	12188.72	432.51
2029	28.437	12297.23	432.44
2030	28.689	12404.77	432.38
2031	28.940	12511.38	432.32
2032	29.188	12617.07	432.26
2033	29.435	12721.86	432.21
2034	29.679	12825.79	432.15
2035	29.921	12928.87	432.10
2036	30.162	13031.12	432.04
2037	30.400	13132.56	431.99

Table C21: Land line Alt. - unit energy costs for residential consumers in Gods River

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	8.970	2.100	6.870	567.55	63.27
1997	14.770	2.100	12.670	845.31	57.23
1998	17.172	2.100	15.072	960.36	55.92
1999	19.016	2.100	16.916	1048.64	55.15
2000	20.570	2.100	18.470	1123.07	54.60
2001	21.939	2.100	19.839	1188.64	54.18
2002	23.177	2.100	21.077	1247.92	53.84
2003	24.315	2.100	22.215	1302.43	53.56
2004	25.375	2.100	23.275	1353.17	53.33
2005	26.370	2.100	24.270	1400.83	53.12
2006	27.311	2.100	25.211	1445.91	52.94
2007	28.206	2.100	26.106	1488.78	52.78
2008	29.062	2.100	26.962	1529.74	52.64
2009	29.882	2.100	27.782	1569.03	52.51
2010	30.672	2.100	28.572	1606.84	52.39
2011	31.433	2.100	29.333	1643.31	52.28
2012	32.170	2.100	30.070	1678.59	52.18
2013	32.884	2.100	30.784	1712.79	52.09
2014	33.577	2.100	31.477	1745.99	52.00
2015	34.252	2.100	32.152	1778.28	51.92
2016	34.908	2.100	32.808	1809.73	51.84
2017	35.549	2.100	33.449	1840.41	51.77
2018	36.174	2.100	34.074	1870.36	51.70
2019	36.786	2.100	34.686	1899.65	51.64
2020	37.384	2.100	35.284	1928.30	51.58
2021	37.970	2.100	35.870	1956.36	51.52
2022	38.544	2.100	36.444	1983.86	51.47
2023	39.108	2.100	37.008	2010.84	51.42
2024	39.661	2.100	37.561	2037.32	51.37
2025	40.204	2.100	38.104	2063.34	51.32
2026	40.738	2.100	38.638	2088.91	51.28
2027	41.263	2.100	39.163	2114.06	51.23
2028	41.780	2.100	39.680	2138.80	51.19
2029	42.288	2.100	40.188	2163.17	51.15
2030	42.790	2.100	40.690	2187.16	51.11
2031	43.283	2.100	41.183	2210.81	51.08
2032	43.770	2.100	41.670	2234.12	51.04
2033	44.250	2.100	42.150	2257.11	51.01
2034	44.724	2.100	42.624	2279.79	50.97
2035	45.191	2.100	43.091	2302.17	50.94
2036	45.652	2.100	43.552	2324.27	50.91
2037	46.108	2.100	44.008	2346.09	50.88

Table C22: Land line Alt. - unit energy costs for nonresidential consumers in Gods Ri

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Third Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	18.224	13.080	5.144	0.000	1341.77	73.63
1997	22.524	13.080	9.444	0.000	1493.86	66.32
1998	26.824	13.080	13.744	0.000	1645.95	61.36
1999	31.124	13.080	18.044	0.000	1798.04	57.77
2000	35.424	13.080	20.000	2.344	1963.68	55.43
2001	39.724	13.080	20.000	6.644	2140.62	53.89
2002	44.024	13.080	20.000	10.944	2317.57	52.64
2003	48.324	13.080	20.000	15.244	2494.51	51.62
2004	52.624	13.080	20.000	19.544	2671.46	50.76
2005	56.924	13.080	20.000	23.844	2848.40	50.04
2006	61.224	13.080	20.000	28.144	3025.35	49.41
2007	65.524	13.080	20.000	32.444	3202.29	48.87
2008	69.824	13.080	20.000	36.744	3379.24	48.40
2009	74.124	13.080	20.000	41.044	3556.18	47.98
2010	78.424	13.080	20.000	45.344	3733.13	47.60
2011	82.724	13.080	20.000	49.644	3910.07	47.27
2012	87.024	13.080	20.000	53.944	4087.02	46.96
2013	91.324	13.080	20.000	58.244	4263.96	46.69
2014	95.624	13.080	20.000	62.544	4440.91	46.44
2015	99.924	13.080	20.000	66.844	4617.85	46.21
2016	104.224	13.080	20.000	71.144	4794.80	46.00
2017	108.524	13.080	20.000	75.444	4971.74	45.81
2018	112.824	13.080	20.000	79.744	5148.69	45.63
2019	117.124	13.080	20.000	84.044	5325.63	45.47
2020	121.424	13.080	20.000	88.344	5502.58	45.32
2021	125.724	13.080	20.000	92.644	5679.52	45.17
2022	130.024	13.080	20.000	96.944	5856.47	45.04
2023	134.324	13.080	20.000	101.244	6033.41	44.92
2024	138.624	13.080	20.000	105.544	6210.36	44.80
2025	142.924	13.080	20.000	109.844	6387.30	44.69
2026	147.224	13.080	20.000	114.144	6564.25	44.59
2027	151.524	13.080	20.000	118.444	6741.19	44.49
2028	155.824	13.080	20.000	122.744	6918.14	44.40
2029	160.124	13.080	20.000	127.044	7095.08	44.31
2030	164.424	13.080	20.000	131.344	7272.03	44.23
2031	168.724	13.080	20.000	135.644	7448.97	44.15
2032	173.024	13.080	20.000	139.944	7625.92	44.07
2033	177.324	13.080	20.000	144.244	7802.86	44.00
2034	181.624	13.080	20.000	148.544	7979.81	43.94
2035	185.924	13.080	20.000	152.844	8156.75	43.87
2036	190.224	13.080	20.000	157.144	8333.70	43.81
2037	194.524	13.080	20.000	161.444	8510.64	43.75

Table C23: Diesel Alt. - unit energy costs for res. cons.in Red S. Lake

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	8.578	2.100	6.478	649.25	75.69
1997	8.918	2.100	6.818	665.64	74.64
1998	9.258	2.100	7.158	682.03	73.67
1999	9.598	2.100	7.498	698.42	72.77
2000	9.938	2.100	7.838	714.81	71.93
2001	10.278	2.100	8.178	731.20	71.14
2002	10.618	2.100	8.518	747.59	70.41
2003	10.958	2.100	8.858	763.99	69.72
2004	11.298	2.100	9.198	780.38	69.07
2005	11.638	2.100	9.538	796.77	68.46
2006	11.978	2.100	9.878	813.16	67.89
2007	12.318	2.100	10.218	829.55	67.34
2008	12.658	2.100	10.558	845.94	66.83
2009	12.998	2.100	10.898	862.33	66.34
2010	13.338	2.100	11.238	878.73	65.88
2011	13.678	2.100	11.578	895.12	65.44
2012	14.018	2.100	11.918	911.51	65.02
2013	14.358	2.100	12.258	927.90	64.63
2014	14.698	2.100	12.598	944.29	64.25
2015	15.038	2.100	12.938	960.68	63.88
2016	15.378	2.100	13.278	977.07	63.54
2017	15.718	2.100	13.618	993.47	63.21
2018	16.058	2.100	13.958	1009.86	62.89
2019	16.398	2.100	14.298	1026.25	62.58
2020	16.738	2.100	14.638	1042.64	62.29
2021	17.078	2.100	14.978	1059.03	62.01
2022	17.418	2.100	15.318	1075.42	61.74
2023	17.758	2.100	15.658	1091.81	61.48
2024	18.098	2.100	15.998	1108.21	61.23
2025	18.438	2.100	16.338	1124.60	60.99
2026	18.778	2.100	16.678	1140.99	60.76
2027	19.118	2.100	17.018	1157.38	60.54
2028	19.458	2.100	17.358	1173.77	60.32
2029	19.798	2.100	17.698	1190.16	60.12
2030	20.138	2.100	18.038	1206.55	59.91
2031	20.478	2.100	18.378	1222.95	59.72
2032	20.818	2.100	18.718	1239.34	59.53
2033	21.158	2.100	19.058	1255.73	59.35
2034	21.498	2.100	19.398	1272.12	59.17
2035	21.838	2.100	19.738	1288.51	59.00
2036	22.178	2.100	20.078	1304.90	58.84
2037	22.518	2.100	20.418	1321.29	58.68

Table C24: Diesel Alt. - unit energy costs for nonres. cons. in Red S. Lake

YEAR	Average Annual Demand (MWh/meter)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	21.952	9538.43	434.51
1997	22.344	9705.19	434.35
1998	22.728	9868.51	434.20
1999	23.104	10028.59	434.06
2000	23.473	10185.63	433.92
2001	23.836	10339.78	433.79
2002	24.192	10491.21	433.67
2003	24.541	10640.04	433.55
2004	24.886	10786.42	433.44
2005	25.224	10930.45	433.33
2006	25.557	11072.25	433.23
2007	25.886	11211.92	433.13
2008	26.209	11349.54	433.04
2009	26.528	11485.22	432.95
2010	26.842	11619.02	432.86
2011	27.153	11751.03	432.77
2012	27.459	11881.31	432.69
2013	27.761	12009.93	432.61
2014	28.060	12136.95	432.54
2015	28.355	12262.44	432.46
2016	28.646	12386.43	432.39
2017	28.934	12509.00	432.32
2018	29.219	12630.18	432.26
2019	29.501	12750.02	432.19
2020	29.779	12868.56	432.13
2021	30.055	12985.85	432.07
2022	30.328	13101.93	432.01
2023	30.598	13216.82	431.95
2024	30.865	13330.58	431.89
2025	31.130	13443.22	431.84
2026	31.392	13554.78	431.79
2027	31.652	13665.30	431.73
2028	31.910	13774.80	431.68
2029	32.165	13883.31	431.63
2030	32.417	13990.85	431.58
2031	32.668	14097.45	431.54
2032	32.916	14203.14	431.49
2033	33.163	14307.94	431.45
2034	33.407	14411.87	431.40
2035	33.649	14514.94	431.36
2036	33.890	14617.20	431.32
2037	34.128	14718.64	431.28

Table C25: Land line Alt. - unit energy costs for res. cons. in Red S. Lake

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	8.578	2.100	6.478	548.77	63.97
1997	14.378	2.100	12.278	826.53	57.49
1998	16.780	2.100	14.680	941.59	56.11
1999	18.624	2.100	16.524	1029.87	55.30
2000	20.178	2.100	18.078	1104.30	54.73
2001	21.547	2.100	19.447	1169.87	54.29
2002	22.785	2.100	20.685	1229.15	53.95
2003	23.923	2.100	21.823	1283.66	53.66
2004	24.983	2.100	22.883	1334.40	53.41
2005	25.978	2.100	23.878	1382.06	53.20
2006	26.919	2.100	24.819	1427.13	53.02
2007	27.814	2.100	25.714	1470.00	52.85
2008	28.670	2.100	26.570	1510.97	52.70
2009	29.490	2.100	27.390	1550.26	52.57
2010	30.280	2.100	28.180	1588.06	52.45
2011	31.041	2.100	28.941	1624.54	52.33
2012	31.778	2.100	29.678	1659.82	52.23
2013	32.492	2.100	30.392	1694.01	52.14
2014	33.185	2.100	31.085	1727.22	52.05
2015	33.860	2.100	31.760	1759.51	51.96
2016	34.516	2.100	32.416	1790.96	51.89
2017	35.157	2.100	33.057	1821.64	51.81
2018	35.782	2.100	33.682	1851.59	51.75
2019	36.394	2.100	34.294	1880.87	51.68
2020	36.992	2.100	34.892	1909.52	51.62
2021	37.578	2.100	35.478	1937.58	51.56
2022	38.152	2.100	36.052	1965.09	51.51
2023	38.716	2.100	36.616	1992.07	51.45
2024	39.269	2.100	37.169	2018.55	51.40
2025	39.812	2.100	37.712	2044.57	51.36
2026	40.346	2.100	38.246	2070.14	51.31
2027	40.871	2.100	38.771	2095.29	51.27
2028	41.388	2.100	39.288	2120.03	51.22
2029	41.896	2.100	39.796	2144.39	51.18
2030	42.398	2.100	40.298	2168.39	51.14
2031	42.891	2.100	40.791	2192.03	51.11
2032	43.378	2.100	41.278	2215.34	51.07
2033	43.858	2.100	41.758	2238.33	51.04
2034	44.332	2.100	42.232	2261.01	51.00
2035	44.799	2.100	42.699	2283.40	50.97
2036	45.260	2.100	43.160	2305.49	50.94
2037	45.716	2.100	43.616	2327.32	50.91

Table C26: Land line Alt. - unit en. costs for nonres. cons. in Red S. Lake

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Third Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	21.952	13.080	8.872	0.000	1473.62	67.13
1997	26.252	13.080	13.172	0.000	1625.72	61.93
1998	30.552	13.080	17.472	0.000	1777.81	58.19
1999	34.852	13.080	20.000	1.772	1929.90	55.37
2000	39.152	13.080	20.000	6.072	2081.99	53.18
2001	43.452	13.080	20.000	10.372	2234.08	51.41
2002	47.752	13.080	20.000	14.672	2386.17	49.97
2003	52.052	13.080	20.000	18.972	2538.26	48.76
2004	56.352	13.080	20.000	23.272	2690.35	47.74
2005	60.652	13.080	20.000	27.572	2842.44	46.86
2006	64.952	13.080	20.000	31.872	2994.53	46.10
2007	69.252	13.080	20.000	36.172	3146.63	45.44
2008	73.552	13.080	20.000	40.472	3298.72	44.85
2009	77.852	13.080	20.000	44.772	3450.81	44.33
2010	82.152	13.080	20.000	49.072	3602.90	43.86
2011	86.452	13.080	20.000	53.372	3754.99	43.43
2012	90.752	13.080	20.000	57.672	3907.08	43.05
2013	95.052	13.080	20.000	61.972	4059.17	42.70
2014	99.352	13.080	20.000	66.272	4211.26	42.39
2015	103.652	13.080	20.000	70.572	4363.35	42.10
2016	107.952	13.080	20.000	74.872	4515.44	41.83
2017	112.252	13.080	20.000	79.172	4667.54	41.58
2018	116.552	13.080	20.000	83.472	4819.63	41.35
2019	120.852	13.080	20.000	87.772	4971.72	41.14
2020	125.152	13.080	20.000	92.072	5123.81	40.94
2021	129.452	13.080	20.000	96.372	5275.90	40.76
2022	133.752	13.080	20.000	100.672	5427.99	40.58
2023	138.052	13.080	20.000	104.972	5580.08	40.42
2024	142.352	13.080	20.000	109.272	5732.17	40.27
2025	146.652	13.080	20.000	113.572	5884.26	40.12
2026	150.952	13.080	20.000	117.872	6036.35	39.99
2027	155.252	13.080	20.000	122.172	6188.45	39.86
2028	159.552	13.080	20.000	126.472	6340.54	39.74
2029	163.852	13.080	20.000	130.772	6492.63	39.62
2030	168.152	13.080	20.000	135.072	6644.72	39.52
2031	172.452	13.080	20.000	139.372	6796.81	39.41
2032	176.752	13.080	20.000	143.672	6948.90	39.31
2033	181.052	13.080	20.000	147.972	7100.99	39.22
2034	185.352	13.080	20.000	152.272	7253.08	39.13
2035	189.652	13.080	20.000	156.572	7405.17	39.05
2036	193.952	13.080	20.000	160.872	7557.26	38.96
2037	198.252	13.080	20.000	165.172	7709.36	38.89

Table C27: Diesel Alt. - unit energy costs for res. cons. in Garden Hill

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	6.649	2.100	4.549	556.25	83.66
1997	6.759	2.100	4.659	561.55	83.08
1998	6.869	2.100	4.769	566.86	82.52
1999	6.979	2.100	4.879	572.16	81.98
2000	7.089	2.100	4.989	577.46	81.46
2001	7.199	2.100	5.099	582.76	80.95
2002	7.309	2.100	5.209	588.07	80.46
2003	7.419	2.100	5.319	593.37	79.98
2004	7.529	2.100	5.429	598.67	79.52
2005	7.639	2.100	5.539	603.98	79.06
2006	7.749	2.100	5.649	609.28	78.63
2007	7.859	2.100	5.759	614.58	78.20
2008	7.969	2.100	5.869	619.89	77.79
2009	8.079	2.100	5.979	625.19	77.38
2010	8.189	2.100	6.089	630.49	76.99
2011	8.299	2.100	6.199	635.80	76.61
2012	8.409	2.100	6.309	641.10	76.24
2013	8.519	2.100	6.419	646.40	75.88
2014	8.629	2.100	6.529	651.71	75.52
2015	8.739	2.100	6.639	657.01	75.18
2016	8.849	2.100	6.749	662.31	74.85
2017	8.959	2.100	6.859	667.61	74.52
2018	9.069	2.100	6.969	672.92	74.20
2019	9.179	2.100	7.079	678.22	73.89
2020	9.289	2.100	7.189	683.52	73.58
2021	9.399	2.100	7.299	688.83	73.29
2022	9.509	2.100	7.409	694.13	73.00
2023	9.619	2.100	7.519	699.43	72.71
2024	9.729	2.100	7.629	704.74	72.44
2025	9.839	2.100	7.739	710.04	72.17
2026	9.949	2.100	7.849	715.34	71.90
2027	10.059	2.100	7.959	720.65	71.64
2028	10.169	2.100	8.069	725.95	71.39
2029	10.279	2.100	8.179	731.25	71.14
2030	10.389	2.100	8.289	736.55	70.90
2031	10.499	2.100	8.399	741.86	70.66
2032	10.609	2.100	8.509	747.16	70.43
2033	10.719	2.100	8.619	752.46	70.20
2034	10.829	2.100	8.729	757.77	69.98
2035	10.939	2.100	8.839	763.07	69.76
2036	11.049	2.100	8.949	768.37	69.54
2037	11.159	2.100	9.059	773.68	69.33

Table C28: Diesel Alt. - unit energy costs for nonres. consumers in Garden Hill

YEAR	Average Annual Demand (MWh/meter)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	23.027	9995.72	434.09
1997	23.277	10102.08	433.99
1998	23.527	10208.44	433.90
1999	23.777	10314.80	433.81
2000	24.027	10421.17	433.73
2001	24.277	10527.53	433.64
2002	24.527	10633.89	433.56
2003	24.777	10740.25	433.48
2004	25.027	10846.62	433.40
2005	25.277	10952.98	433.32
2006	25.527	11059.34	433.24
2007	25.777	11165.70	433.17
2008	26.027	11272.07	433.09
2009	26.277	11378.43	433.02
2010	26.527	11484.79	432.95
2011	26.777	11591.15	432.88
2012	27.027	11697.52	432.81
2013	27.277	11803.88	432.74
2014	27.527	11910.24	432.67
2015	27.777	12016.60	432.61
2016	28.027	12122.97	432.55
2017	28.277	12229.33	432.48
2018	28.527	12335.69	432.42
2019	28.777	12442.05	432.36
2020	29.027	12548.42	432.30
2021	29.277	12654.78	432.24
2022	29.527	12761.14	432.19
2023	29.777	12867.50	432.13
2024	30.027	12973.87	432.07
2025	30.277	13080.23	432.02
2026	30.527	13186.59	431.96
2027	30.777	13292.95	431.91
2028	31.027	13399.32	431.86
2029	31.277	13505.68	431.81
2030	31.527	13612.04	431.76
2031	31.777	13718.40	431.71
2032	32.027	13824.77	431.66
2033	32.277	13931.13	431.61
2034	32.527	14037.49	431.56
2035	32.777	14143.85	431.52
2036	33.027	14250.22	431.47
2037	33.277	14356.58	431.43

Table C29: Land line Alt. - unit energy costs for res. consumers in Garden Hill

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	6.649	2.100	4.549	456.39	68.64
1997	12.449	2.100	10.349	734.15	58.97
1998	14.851	2.100	12.751	849.21	57.18
1999	16.695	2.100	14.595	937.49	56.15
2000	18.249	2.100	16.149	1011.92	55.45
2001	19.618	2.100	17.518	1077.49	54.92
2002	20.856	2.100	18.756	1136.77	54.51
2003	21.994	2.100	19.894	1191.28	54.16
2004	23.054	2.100	20.954	1242.02	53.87
2005	24.049	2.100	21.949	1289.68	53.63
2006	24.990	2.100	22.890	1334.75	53.41
2007	25.885	2.100	23.785	1377.62	53.22
2008	26.741	2.100	24.641	1418.59	53.05
2009	27.561	2.100	25.461	1457.88	52.90
2010	28.351	2.100	26.251	1495.68	52.76
2011	29.112	2.100	27.012	1532.16	52.63
2012	29.849	2.100	27.749	1567.44	52.51
2013	30.563	2.100	28.463	1601.63	52.40
2014	31.256	2.100	29.156	1634.84	52.30
2015	31.931	2.100	29.831	1667.13	52.21
2016	32.587	2.100	30.487	1698.58	52.12
2017	33.228	2.100	31.128	1729.26	52.04
2018	33.853	2.100	31.753	1759.21	51.97
2019	34.465	2.100	32.365	1788.49	51.89
2020	35.063	2.100	32.963	1817.14	51.82
2021	35.649	2.100	33.549	1845.20	51.76
2022	36.223	2.100	34.123	1872.71	51.70
2023	36.787	2.100	34.687	1899.69	51.64
2024	37.340	2.100	35.240	1926.17	51.59
2025	37.883	2.100	35.783	1952.19	51.53
2026	38.417	2.100	36.317	1977.76	51.48
2027	38.942	2.100	36.842	2002.91	51.43
2028	39.459	2.100	37.359	2027.65	51.39
2029	39.967	2.100	37.867	2052.01	51.34
2030	40.469	2.100	38.369	2076.01	51.30
2031	40.962	2.100	38.862	2099.65	51.26
2032	41.449	2.100	39.349	2122.96	51.22
2033	41.929	2.100	39.829	2145.95	51.18
2034	42.403	2.100	40.303	2168.63	51.14
2035	42.870	2.100	40.770	2191.02	51.11
2036	43.331	2.100	41.231	2213.11	51.07
2037	43.787	2.100	41.687	2234.94	51.04

Table C30: Land line Alt. - unit energy costs for nonres. cons. in Garden Hill

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Third Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	23.027	13.080	9.947	0.000	1511.64	65.65
1997	27.327	13.080	14.247	0.000	1663.73	60.88
1998	31.627	13.080	18.547	0.000	1815.82	57.41
1999	35.927	13.080	20.000	2.847	1984.37	55.23
2000	40.227	13.080	20.000	7.147	2161.32	53.73
2001	44.527	13.080	20.000	11.447	2338.26	52.51
2002	48.827	13.080	20.000	15.747	2515.21	51.51
2003	53.127	13.080	20.000	20.047	2692.15	50.67
2004	57.427	13.080	20.000	24.347	2869.10	49.96
2005	61.727	13.080	20.000	28.647	3046.04	49.35
2006	66.027	13.080	20.000	32.947	3222.99	48.81
2007	70.327	13.080	20.000	37.247	3399.93	48.34
2008	74.627	13.080	20.000	41.547	3576.88	47.93
2009	78.927	13.080	20.000	45.847	3753.82	47.56
2010	83.227	13.080	20.000	50.147	3930.77	47.23
2011	87.527	13.080	20.000	54.447	4107.71	46.93
2012	91.827	13.080	20.000	58.747	4284.66	46.66
2013	96.127	13.080	20.000	63.047	4461.60	46.41
2014	100.427	13.080	20.000	67.347	4638.55	46.19
2015	104.727	13.080	20.000	71.647	4815.49	45.98
2016	109.027	13.080	20.000	75.947	4992.44	45.79
2017	113.327	13.080	20.000	80.247	5169.38	45.61
2018	117.627	13.080	20.000	84.547	5346.33	45.45
2019	121.927	13.080	20.000	88.847	5523.27	45.30
2020	126.227	13.080	20.000	93.147	5700.22	45.16
2021	130.527	13.080	20.000	97.447	5877.16	45.03
2022	134.827	13.080	20.000	101.747	6054.11	44.90
2023	139.127	13.080	20.000	106.047	6231.05	44.79
2024	143.427	13.080	20.000	110.347	6408.00	44.68
2025	147.727	13.080	20.000	114.647	6584.94	44.58
2026	152.027	13.080	20.000	118.947	6761.89	44.48
2027	156.327	13.080	20.000	123.247	6938.83	44.39
2028	160.627	13.080	20.000	127.547	7115.78	44.30
2029	164.927	13.080	20.000	131.847	7292.72	44.22
2030	169.227	13.080	20.000	136.147	7469.67	44.14
2031	173.527	13.080	20.000	140.447	7646.61	44.07
2032	177.827	13.080	20.000	144.747	7823.56	44.00
2033	182.127	13.080	20.000	149.047	8000.50	43.93
2034	186.427	13.080	20.000	153.347	8177.45	43.86
2035	190.727	13.080	20.000	157.647	8354.39	43.80
2036	195.027	13.080	20.000	161.947	8531.34	43.74
2037	199.327	13.080	20.000	166.247	8708.28	43.69

Table C31: Diesel Alt. - unit energy costs for res. cons. in St. T. Point

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	6.971	2.100	4.871	571.77	82.02
1997	7.121	2.100	5.021	579.00	81.31
1998	7.271	2.100	5.171	586.24	80.63
1999	7.421	2.100	5.321	593.47	79.97
2000	7.571	2.100	5.471	600.70	79.34
2001	7.721	2.100	5.621	607.93	78.74
2002	7.871	2.100	5.771	615.16	78.16
2003	8.021	2.100	5.921	622.39	77.60
2004	8.171	2.100	6.071	629.62	77.06
2005	8.321	2.100	6.221	636.86	76.54
2006	8.471	2.100	6.371	644.09	76.03
2007	8.621	2.100	6.521	651.32	75.55
2008	8.771	2.100	6.671	658.55	75.08
2009	8.921	2.100	6.821	665.78	74.63
2010	9.071	2.100	6.971	673.01	74.19
2011	9.221	2.100	7.121	680.25	73.77
2012	9.371	2.100	7.271	687.48	73.36
2013	9.521	2.100	7.421	694.71	72.97
2014	9.671	2.100	7.571	701.94	72.58
2015	9.821	2.100	7.721	709.17	72.21
2016	9.971	2.100	7.871	716.40	71.85
2017	10.121	2.100	8.021	723.63	71.50
2018	10.271	2.100	8.171	730.87	71.16
2019	10.421	2.100	8.321	738.10	70.83
2020	10.571	2.100	8.471	745.33	70.51
2021	10.721	2.100	8.621	752.56	70.19
2022	10.871	2.100	8.771	759.79	69.89
2023	11.021	2.100	8.921	767.02	69.60
2024	11.171	2.100	9.071	774.25	69.31
2025	11.321	2.100	9.221	781.49	69.03
2026	11.471	2.100	9.371	788.72	68.76
2027	11.621	2.100	9.521	795.95	68.49
2028	11.771	2.100	9.671	803.18	68.23
2029	11.921	2.100	9.821	810.41	67.98
2030	12.071	2.100	9.971	817.64	67.74
2031	12.221	2.100	10.121	824.88	67.50
2032	12.371	2.100	10.271	832.11	67.26
2033	12.521	2.100	10.421	839.34	67.03
2034	12.671	2.100	10.571	846.57	66.81
2035	12.821	2.100	10.721	853.80	66.59
2036	12.971	2.100	10.871	861.03	66.38
2037	13.121	2.100	11.021	868.26	66.17

Table C32: Diesel Alt. - unit energy costs for nonres. cons. in St. T. Point

YEAR	Average Annual Demand (MWh/meter)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	27.093	11725.59	432.79
1997	27.516	11905.51	432.68
1998	27.930	12081.73	432.57
1999	28.336	12254.45	432.47
2000	28.734	12423.88	432.37
2001	29.125	12590.21	432.28
2002	29.509	12753.59	432.19
2003	29.887	12914.17	432.11
2004	30.258	13072.11	432.02
2005	30.623	13227.51	431.95
2006	30.983	13380.50	431.87
2007	31.337	13531.20	431.80
2008	31.686	13679.69	431.73
2009	32.030	13826.08	431.66
2010	32.369	13970.44	431.60
2011	32.704	14112.87	431.53
2012	33.034	14253.44	431.47
2013	33.361	14392.21	431.41
2014	33.683	14529.26	431.36
2015	34.001	14664.66	431.30
2016	34.315	14798.44	431.25
2017	34.626	14930.68	431.19
2018	34.934	15061.43	431.14
2019	35.238	15190.73	431.09
2020	35.538	15318.64	431.05
2021	35.836	15445.19	431.00
2022	36.130	15570.42	430.96
2023	36.421	15694.39	430.91
2024	36.710	15817.13	430.87
2025	36.996	15938.66	430.83
2026	37.278	16059.03	430.79
2027	37.559	16178.28	430.75
2028	37.836	16296.42	430.71
2029	38.112	16413.49	430.67
2030	38.384	16529.53	430.63
2031	38.655	16644.55	430.60
2032	38.923	16758.58	430.56
2033	39.188	16871.65	430.53
2034	39.452	16983.78	430.49
2035	39.713	17095.00	430.46
2036	39.973	17205.32	430.43
2037	40.230	17314.77	430.39

Table C33: Land line Alt. - unit energy costs for res. cons. in St. T. Point

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	6.971	2.100	4.871	471.81	67.68
1997	12.771	2.100	10.671	749.58	58.69
1998	15.173	2.100	13.073	864.63	56.98
1999	17.017	2.100	14.917	952.91	56.00
2000	18.571	2.100	16.471	1027.34	55.32
2001	19.940	2.100	17.840	1092.91	54.81
2002	21.178	2.100	19.078	1152.19	54.40
2003	22.316	2.100	20.216	1206.70	54.07
2004	23.376	2.100	21.276	1257.44	53.79
2005	24.371	2.100	22.271	1305.10	53.55
2006	25.312	2.100	23.212	1350.17	53.34
2007	26.207	2.100	24.107	1393.05	53.15
2008	27.063	2.100	24.963	1434.01	52.99
2009	27.883	2.100	25.783	1473.30	52.84
2010	28.673	2.100	26.573	1511.10	52.70
2011	29.434	2.100	27.334	1547.58	52.58
2012	30.171	2.100	28.071	1582.86	52.46
2013	30.885	2.100	28.785	1617.06	52.36
2014	31.578	2.100	29.478	1650.26	52.26
2015	32.253	2.100	30.153	1682.55	52.17
2016	32.909	2.100	30.809	1714.00	52.08
2017	33.550	2.100	31.450	1744.68	52.00
2018	34.175	2.100	32.075	1774.63	51.93
2019	34.787	2.100	32.687	1803.91	51.86
2020	35.385	2.100	33.285	1832.56	51.79
2021	35.971	2.100	33.871	1860.62	51.73
2022	36.545	2.100	34.445	1888.13	51.67
2023	37.109	2.100	35.009	1915.11	51.61
2024	37.662	2.100	35.562	1941.59	51.55
2025	38.205	2.100	36.105	1967.61	51.50
2026	38.739	2.100	36.639	1993.18	51.45
2027	39.264	2.100	37.164	2018.33	51.40
2028	39.781	2.100	37.681	2043.07	51.36
2029	40.289	2.100	38.189	2067.43	51.31
2030	40.791	2.100	38.691	2091.43	51.27
2031	41.284	2.100	39.184	2115.08	51.23
2032	41.771	2.100	39.671	2138.39	51.19
2033	42.251	2.100	40.151	2161.37	51.16
2034	42.725	2.100	40.625	2184.05	51.12
2035	43.192	2.100	41.092	2206.44	51.08
2036	43.653	2.100	41.553	2228.53	51.05
2037	44.109	2.100	42.009	2250.36	51.02

Table C34: Land line Alt. - unit en. costs for nonres. cons. in St. T. Point

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Third Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	27.093	13.080	14.013	0.000	1655.45	61.10
1997	31.393	13.080	18.313	0.000	1807.54	57.58
1998	35.693	13.080	20.000	2.613	1974.74	55.33
1999	39.993	13.080	20.000	6.913	2151.68	53.80
2000	44.293	13.080	20.000	11.213	2328.63	52.57
2001	48.593	13.080	20.000	15.513	2505.57	51.56
2002	52.893	13.080	20.000	19.813	2682.52	50.72
2003	57.193	13.080	20.000	24.113	2859.46	50.00
2004	61.493	13.080	20.000	28.413	3036.41	49.38
2005	65.793	13.080	20.000	32.713	3213.35	48.84
2006	70.093	13.080	20.000	37.013	3390.30	48.37
2007	74.393	13.080	20.000	41.313	3567.24	47.95
2008	78.693	13.080	20.000	45.613	3744.19	47.58
2009	82.993	13.080	20.000	49.913	3921.13	47.25
2010	87.293	13.080	20.000	54.213	4098.08	46.95
2011	91.593	13.080	20.000	58.513	4275.02	46.67
2012	95.893	13.080	20.000	62.813	4451.97	46.43
2013	100.193	13.080	20.000	67.113	4628.91	46.20
2014	104.493	13.080	20.000	71.413	4805.86	45.99
2015	108.793	13.080	20.000	75.713	4982.80	45.80
2016	113.093	13.080	20.000	80.013	5159.75	45.62
2017	117.393	13.080	20.000	84.313	5336.69	45.46
2018	121.693	13.080	20.000	88.613	5513.64	45.31
2019	125.993	13.080	20.000	92.913	5690.58	45.17
2020	130.293	13.080	20.000	97.213	5867.53	45.03
2021	134.593	13.080	20.000	101.513	6044.47	44.91
2022	138.893	13.080	20.000	105.813	6221.42	44.79
2023	143.193	13.080	20.000	110.113	6398.36	44.68
2024	147.493	13.080	20.000	114.413	6575.31	44.58
2025	151.793	13.080	20.000	118.713	6752.25	44.48
2026	156.093	13.080	20.000	123.013	6929.20	44.39
2027	160.393	13.080	20.000	127.313	7106.14	44.30
2028	164.693	13.080	20.000	131.613	7283.09	44.22
2029	168.993	13.080	20.000	135.913	7460.03	44.14
2030	173.293	13.080	20.000	140.213	7636.98	44.07
2031	177.593	13.080	20.000	144.513	7813.92	44.00
2032	181.893	13.080	20.000	148.813	7990.87	43.93
2033	186.193	13.080	20.000	153.113	8167.81	43.87
2034	190.493	13.080	20.000	157.413	8344.76	43.81
2035	194.793	13.080	20.000	161.713	8521.70	43.75
2036	199.093	13.080	20.000	166.013	8698.65	43.69
2037	203.393	13.080	20.000	170.313	8875.59	43.64

Table C35: Diesel Alt. - unit energy costs for res. cons. in Wasagamack

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	6.733	2.100	4.633	560.30	83.22
1997	6.873	2.100	4.773	567.05	82.50
1998	7.013	2.100	4.913	573.80	81.82
1999	7.153	2.100	5.053	580.55	81.16
2000	7.293	2.100	5.193	587.30	80.53
2001	7.433	2.100	5.333	594.05	79.92
2002	7.573	2.100	5.473	600.80	79.33
2003	7.713	2.100	5.613	607.54	78.77
2004	7.853	2.100	5.753	614.29	78.22
2005	7.993	2.100	5.893	621.04	77.70
2006	8.133	2.100	6.033	627.79	77.19
2007	8.273	2.100	6.173	634.54	76.70
2008	8.413	2.100	6.313	641.29	76.23
2009	8.553	2.100	6.453	648.04	75.77
2010	8.693	2.100	6.593	654.79	75.32
2011	8.833	2.100	6.733	661.54	74.89
2012	8.973	2.100	6.873	668.29	74.48
2013	9.113	2.100	7.013	675.04	74.07
2014	9.253	2.100	7.153	681.79	73.68
2015	9.393	2.100	7.293	688.54	73.30
2016	9.533	2.100	7.433	695.29	72.93
2017	9.673	2.100	7.573	702.04	72.58
2018	9.813	2.100	7.713	708.79	72.23
2019	9.953	2.100	7.853	715.54	71.89
2020	10.093	2.100	7.993	722.28	71.56
2021	10.233	2.100	8.133	729.03	71.24
2022	10.373	2.100	8.273	735.78	70.93
2023	10.513	2.100	8.413	742.53	70.63
2024	10.653	2.100	8.553	749.28	70.34
2025	10.793	2.100	8.693	756.03	70.05
2026	10.933	2.100	8.833	762.78	69.77
2027	11.073	2.100	8.973	769.53	69.50
2028	11.213	2.100	9.113	776.28	69.23
2029	11.353	2.100	9.253	783.03	68.97
2030	11.493	2.100	9.393	789.78	68.72
2031	11.633	2.100	9.533	796.53	68.47
2032	11.773	2.100	9.673	803.28	68.23
2033	11.913	2.100	9.813	810.03	68.00
2034	12.053	2.100	9.953	816.78	67.77
2035	12.193	2.100	10.093	823.53	67.54
2036	12.333	2.100	10.233	830.27	67.32
2037	12.473	2.100	10.373	837.02	67.11

Table C36: Diesel Alt. - unit energy costs for nonres. cons. in Wasagamack

YEAR	Average Annual Demand (MWh/meter)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	61.767	26477.61	428.67
1997	62.932	26973.50	428.61
1998	64.074	27459.16	428.55
1999	65.193	27935.21	428.50
2000	66.291	28402.18	428.45
2001	67.368	28860.59	428.40
2002	68.426	29310.88	428.36
2003	69.467	29753.47	428.31
2004	70.490	30188.74	428.27
2005	71.496	30617.05	428.23
2006	72.488	31038.71	428.19
2007	73.464	31454.04	428.16
2008	74.426	31863.29	428.12
2009	75.374	32266.75	428.09
2010	76.309	32664.64	428.06
2011	77.232	33057.18	428.03
2012	78.142	33444.60	428.00
2013	79.041	33827.08	427.97
2014	79.929	34204.80	427.94
2015	80.806	34577.95	427.91
2016	81.673	34946.68	427.89
2017	82.530	35311.15	427.86
2018	83.377	35671.50	427.84
2019	84.214	36027.87	427.81
2020	85.043	36380.38	427.79
2021	85.863	36729.16	427.77
2022	86.674	37074.33	427.74
2023	87.477	37416.00	427.72
2024	88.272	37754.26	427.70
2025	89.059	38089.23	427.68
2026	89.839	38420.99	427.66
2027	90.612	38749.63	427.64
2028	91.377	39075.24	427.63
2029	92.135	39397.91	427.61
2030	92.887	39717.71	427.59
2031	93.632	40034.71	427.57
2032	94.371	40349.00	427.56
2033	95.103	40660.63	427.54
2034	95.830	40969.68	427.53
2035	96.550	41276.20	427.51
2036	97.265	41580.26	427.49
2037	97.974	41881.92	427.48

Table C37: Land line Alt. - unit energy costs for res. cons. in Wasagamack

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	6.733	2.100	4.633	460.42	68.38
1997	12.533	2.100	10.433	738.18	58.90
1998	14.935	2.100	12.835	853.23	57.13
1999	16.779	2.100	14.679	941.51	56.11
2000	18.333	2.100	16.233	1015.94	55.42
2001	19.702	2.100	17.602	1081.51	54.89
2002	20.940	2.100	18.840	1140.79	54.48
2003	22.078	2.100	19.978	1195.30	54.14
2004	23.138	2.100	21.038	1246.04	53.85
2005	24.133	2.100	22.033	1293.70	53.61
2006	25.074	2.100	22.974	1338.78	53.39
2007	25.969	2.100	23.869	1381.65	53.20
2008	26.825	2.100	24.725	1422.61	53.03
2009	27.645	2.100	25.545	1461.90	52.88
2010	28.435	2.100	26.335	1499.71	52.74
2011	29.196	2.100	27.096	1536.18	52.62
2012	29.933	2.100	27.833	1571.46	52.50
2013	30.647	2.100	28.547	1605.66	52.39
2014	31.340	2.100	29.240	1638.86	52.29
2015	32.015	2.100	29.915	1671.15	52.20
2016	32.671	2.100	30.571	1702.60	52.11
2017	33.312	2.100	31.212	1733.28	52.03
2018	33.937	2.100	31.837	1763.23	51.96
2019	34.549	2.100	32.449	1792.52	51.88
2020	35.147	2.100	33.047	1821.17	51.82
2021	35.733	2.100	33.633	1849.23	51.75
2022	36.307	2.100	34.207	1876.73	51.69
2023	36.871	2.100	34.771	1903.71	51.63
2024	37.424	2.100	35.324	1930.19	51.58
2025	37.967	2.100	35.867	1956.21	51.52
2026	38.501	2.100	36.401	1981.78	51.47
2027	39.026	2.100	36.926	2006.93	51.43
2028	39.543	2.100	37.443	2031.67	51.38
2029	40.051	2.100	37.951	2056.04	51.33
2030	40.553	2.100	38.453	2080.03	51.29
2031	41.046	2.100	38.946	2103.68	51.25
2032	41.533	2.100	39.433	2126.99	51.21
2033	42.013	2.100	39.913	2149.98	51.17
2034	42.487	2.100	40.387	2172.66	51.14
2035	42.954	2.100	40.854	2195.04	51.10
2036	43.415	2.100	41.315	2217.14	51.07
2037	43.871	2.100	41.771	2238.96	51.03

Table C38: Land line Alt. - unit en. costs for nonres. cons. in Wasagamack

YEAR	Average Annual Demand (MWh/meter)	First Block (MWh)	Second Block (MWh)	Third Block (MWh)	Average Annual Cost (1993$/meter)	Average Annual Unit Energy Cost (1993$/MWh/meter)
1996	61.767	13.080	20.000	28.687	3047.68	49.34
1997	66.067	13.080	20.000	32.987	3224.63	48.81
1998	70.367	13.080	20.000	37.287	3401.57	48.34
1999	74.667	13.080	20.000	41.587	3578.52	47.93
2000	78.967	13.080	20.000	45.887	3755.46	47.56
2001	83.267	13.080	20.000	50.187	3932.41	47.23
2002	87.567	13.080	20.000	54.487	4109.35	46.93
2003	91.867	13.080	20.000	58.787	4286.30	46.66
2004	96.167	13.080	20.000	63.087	4463.24	46.41
2005	100.467	13.080	20.000	67.387	4640.19	46.19
2006	104.767	13.080	20.000	71.687	4817.13	45.98
2007	109.067	13.080	20.000	75.987	4994.08	45.79
2008	113.367	13.080	20.000	80.287	5171.02	45.61
2009	117.667	13.080	20.000	84.587	5347.97	45.45
2010	121.967	13.080	20.000	88.887	5524.91	45.30
2011	126.267	13.080	20.000	93.187	5701.86	45.16
2012	130.567	13.080	20.000	97.487	5878.80	45.03
2013	134.867	13.080	20.000	101.787	6055.75	44.90
2014	139.167	13.080	20.000	106.087	6232.69	44.79
2015	143.467	13.080	20.000	110.387	6409.64	44.68
2016	147.767	13.080	20.000	114.687	6586.58	44.57
2017	152.067	13.080	20.000	118.987	6763.53	44.48
2018	156.367	13.080	20.000	123.287	6940.47	44.39
2019	160.667	13.080	20.000	127.587	7117.42	44.30
2020	164.967	13.080	20.000	131.887	7294.36	44.22
2021	169.267	13.080	20.000	136.187	7471.31	44.14
2022	173.567	13.080	20.000	140.487	7648.25	44.07
2023	177.867	13.080	20.000	144.787	7825.20	43.99
2024	182.167	13.080	20.000	149.087	8002.14	43.93
2025	186.467	13.080	20.000	153.387	8179.09	43.86
2026	190.767	13.080	20.000	157.687	8356.03	43.80
2027	195.067	13.080	20.000	161.987	8532.98	43.74
2028	199.367	13.080	20.000	166.287	8709.92	43.69
2029	203.667	13.080	20.000	170.587	8886.87	43.63
2030	207.967	13.080	20.000	174.887	9063.81	43.58
2031	212.267	13.080	20.000	179.187	9240.76	43.53
2032	216.567	13.080	20.000	183.487	9417.70	43.49
2033	220.867	13.080	20.000	187.787	9594.65	43.44
2034	225.167	13.080	20.000	192.087	9771.59	43.40
2035	229.467	13.080	20.000	196.387	9948.54	43.35
2036	233.767	13.080	20.000	200.687	10125.48	43.31
2037	238.067	13.080	20.000	204.987	10302.43	43.28

Appendix D:

Distributive Fairness Measure Calculations

Table D1: Diesel scenario - intra. SOAD of unit energy costs for res. cons.

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	201.02	200.89	205.53	124.08	121.12	113.48	111.08	115.24	111.08	113.47
1997	195.97	195.85	200.41	122.11	119.71	112.46	109.97	114.67	109.97	112.36
1998	191.20	191.08	195.57	120.16	118.27	111.39	108.82	114.02	108.82	111.20
1999	186.67	186.55	190.98	118.23	116.82	110.26	107.64	113.30	107.64	110.02
2000	182.36	182.25	186.61	116.32	115.35	109.10	106.44	112.53	106.44	108.81
2001	178.26	178.15	182.45	114.45	113.89	107.92	105.22	111.71	105.22	107.59
2002	174.35	174.24	178.49	112.61	112.43	106.72	104.00	110.85	104.00	106.36
2003	170.62	170.51	174.70	110.85	111.02	105.51	102.78	109.97	102.78	105.12
2004	167.05	166.94	171.08	109.16	109.66	104.29	101.56	109.06	101.56	103.89
2005	163.63	163.52	167.61	107.71	108.32	103.08	100.34	108.35	100.34	102.67
2006	160.35	160.25	164.29	106.32	107.14	101.87	99.14	107.80	99.14	101.45
2007	157.21	157.11	161.10	104.95	105.96	100.66	97.94	107.21	97.94	100.24
2008	154.19	154.09	158.04	103.60	104.79	99.47	96.76	106.59	96.76	99.05
2009	151.29	151.19	155.10	102.26	103.63	98.29	95.60	105.95	95.60	97.87
2010	148.50	148.40	152.26	100.96	102.49	97.12	94.44	105.29	94.44	96.70
2011	145.81	145.71	149.53	99.67	101.35	95.97	93.31	104.62	93.31	95.56
2012	143.21	143.12	146.90	98.41	100.23	94.83	92.19	103.93	92.19	94.42
2013	140.71	140.62	144.36	97.17	99.12	93.71	91.09	103.22	91.09	93.31
2014	138.30	138.20	141.91	95.96	98.02	92.60	90.01	102.51	90.01	92.21
2015	135.97	135.87	139.55	94.76	96.95	91.51	88.95	101.80	88.95	91.13
2016	133.71	133.62	137.26	93.60	95.88	90.44	87.90	101.08	87.90	90.07
2017	131.53	131.44	135.04	92.45	94.84	89.39	86.87	100.35	86.87	89.03
2018	129.42	129.33	132.90	91.33	93.81	88.36	85.86	99.62	85.86	88.01
2019	127.37	127.29	130.83	90.23	92.79	87.34	84.87	98.89	84.87	87.00
2020	125.39	125.31	128.82	89.15	91.79	86.35	83.90	98.16	83.90	86.01
2021	123.47	123.39	126.87	88.09	90.81	85.37	82.94	97.44	82.94	85.04
2022	121.61	121.53	124.98	87.06	89.84	84.40	82.01	96.71	82.01	84.09
2023	119.80	119.72	123.14	86.04	88.89	83.46	81.09	95.99	81.09	83.15
2024	118.05	117.96	121.36	85.05	87.96	82.53	80.18	95.26	80.18	82.24
2025	116.34	116.26	119.63	84.07	87.04	81.62	79.30	94.55	79.30	81.34
2026	114.69	114.60	117.94	83.12	86.14	80.73	78.43	93.84	78.43	80.45
2027	113.07	112.99	116.31	82.18	85.25	79.85	77.58	93.13	77.58	79.58
2028	111.51	111.43	114.72	81.27	84.38	78.99	76.74	92.42	76.74	78.73
2029	109.98	109.90	113.17	80.37	83.53	78.14	75.92	91.73	75.92	77.90
2030	108.50	108.42	111.66	79.48	82.68	77.31	75.11	91.03	75.11	77.07
2031	107.05	106.97	110.19	78.62	81.86	76.50	74.32	90.35	74.32	76.27
2032	105.64	105.57	108.76	77.77	81.04	75.70	73.54	89.67	73.54	75.48
2033	104.27	104.19	107.37	76.94	80.24	74.92	72.78	88.99	72.78	74.70
2034	102.93	102.86	106.01	76.13	79.46	74.14	72.03	88.32	72.03	73.94
2035	101.63	101.55	104.68	75.33	78.69	73.39	71.30	87.66	71.30	73.19
2036	100.35	100.28	103.39	74.54	77.93	72.65	70.58	87.01	70.58	72.46
2037	99.11	99.04	102.13	73.78	77.18	71.92	69.87	86.36	69.87	71.73

Table D2: Diesel scenario - intratemporal SOAD of unit energy costs for nonres. cons.

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	2712.00	2714.81	2713.09	1174.45	1177.44	1194.21	1179.38	1177.04	1174.45	1180.75
1997	2712.45	2715.09	2714.08	1174.55	1177.74	1193.30	1179.04	1177.18	1174.55	1180.78
1998	2712.85	2715.33	2714.95	1174.62	1178.01	1192.44	1178.70	1177.28	1174.62	1180.79
1999	2713.20	2715.58	2715.77	1174.67	1178.26	1191.62	1178.38	1177.36	1174.67	1180.78
2000	2713.51	2715.88	2716.57	1174.71	1178.61	1190.86	1178.20	1177.42	1174.71	1180.75
2001	2713.79	2716.14	2717.27	1174.73	1178.98	1190.13	1178.06	1177.45	1174.73	1180.71
2002	2714.03	2716.37	2717.89	1174.74	1179.32	1189.44	1177.92	1177.47	1174.74	1180.67
2003	2714.25	2716.57	2718.44	1174.74	1179.63	1188.78	1177.79	1177.48	1174.74	1180.61
2004	2714.44	2716.74	2718.92	1174.72	1179.92	1188.16	1177.65	1177.47	1174.72	1180.54
2005	2714.61	2716.88	2719.35	1174.70	1180.18	1187.56	1177.51	1177.45	1174.70	1180.47
2006	2714.75	2717.01	2719.72	1174.67	1180.43	1186.99	1177.40	1177.44	1174.67	1180.39
2007	2714.88	2717.11	2720.05	1174.64	1180.66	1186.45	1177.31	1177.44	1174.64	1180.31
2008	2715.00	2717.20	2720.34	1174.60	1180.87	1185.93	1177.22	1177.43	1174.60	1180.22
2009	2715.09	2717.28	2720.59	1174.56	1181.07	1185.43	1177.13	1177.42	1174.56	1180.13
2010	2715.18	2717.33	2720.81	1174.51	1181.25	1184.95	1177.03	1177.39	1174.51	1180.04
2011	2715.25	2717.38	2721.00	1174.45	1181.43	1184.49	1176.94	1177.35	1174.45	1179.94
2012	2715.31	2717.42	2721.17	1174.40	1181.59	1184.05	1176.84	1177.30	1174.40	1179.85
2013	2715.36	2717.44	2721.31	1174.34	1181.74	1183.63	1176.74	1177.25	1174.34	1179.75
2014	2715.41	2717.46	2721.43	1174.28	1181.88	1183.22	1176.64	1177.19	1174.28	1179.64
2015	2715.44	2717.47	2721.53	1174.21	1182.01	1182.82	1176.54	1177.12	1174.21	1179.54
2016	2715.47	2717.47	2721.61	1174.15	1182.13	1182.44	1176.44	1177.05	1174.15	1179.44
2017	2715.49	2717.46	2721.68	1174.08	1182.29	1182.12	1176.34	1176.98	1174.08	1179.33
2018	2715.50	2717.45	2721.73	1174.01	1182.51	1181.88	1176.24	1176.90	1174.01	1179.23
2019	2715.50	2717.44	2721.77	1173.94	1182.73	1181.65	1176.13	1176.81	1173.94	1179.12
2020	2715.51	2717.41	2721.80	1173.87	1182.93	1181.42	1176.03	1176.72	1173.87	1179.02
2021	2715.50	2717.39	2721.82	1173.80	1183.12	1181.20	1175.93	1176.63	1173.80	1178.91
2022	2715.49	2717.36	2721.83	1173.73	1183.30	1180.99	1175.83	1176.54	1173.73	1178.80
2023	2715.48	2717.32	2721.83	1173.65	1183.47	1180.78	1175.73	1176.45	1173.65	1178.70
2024	2715.47	2717.28	2721.82	1173.58	1183.64	1180.58	1175.63	1176.35	1173.58	1178.59
2025	2715.45	2717.24	2721.81	1173.51	1183.79	1180.38	1175.53	1176.25	1173.51	1178.49
2026	2715.42	2717.20	2721.78	1173.43	1183.94	1180.19	1175.43	1176.15	1173.43	1178.38
2027	2715.40	2717.15	2721.75	1173.36	1184.08	1180.01	1175.33	1176.05	1173.36	1178.28
2028	2715.37	2717.10	2721.72	1173.28	1184.22	1179.83	1175.23	1175.94	1173.28	1178.18
2029	2715.34	2717.05	2721.68	1173.21	1184.35	1179.65	1175.14	1175.84	1173.21	1178.07
2030	2715.31	2717.00	2721.64	1173.13	1184.47	1179.48	1175.04	1175.73	1173.13	1177.97
2031	2715.27	2716.94	2721.59	1173.06	1184.59	1179.31	1174.94	1175.63	1173.06	1177.87
2032	2715.24	2716.89	2721.54	1172.99	1184.70	1179.14	1174.85	1175.52	1172.99	1177.77
2033	2715.20	2716.83	2721.48	1172.91	1184.81	1178.98	1174.76	1175.41	1172.91	1177.67
2034	2715.16	2716.77	2721.43	1172.84	1184.91	1178.83	1174.66	1175.31	1172.84	1177.57
2035	2715.11	2716.71	2721.36	1172.77	1185.01	1178.67	1174.57	1175.20	1172.77	1177.47
2036	2715.07	2716.65	2721.30	1172.69	1185.10	1178.52	1174.48	1175.09	1172.69	1177.37
2037	2715.03	2716.59	2721.24	1172.62	1185.19	1178.38	1174.39	1174.98	1172.62	1177.28

Table D3: Land line scenario - intratemporal SOAD of unit energy costs for res. cons.

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	102.89	102.77	107.40	66.42	64.69	60.22	58.81	61.24	58.81	60.21
1997	42.51	42.39	46.96	25.29	24.81	23.65	23.14	23.84	23.14	23.55
1998	31.43	31.31	35.81	18.60	18.26	17.46	17.08	17.58	17.08	17.37
1999	25.25	25.13	29.56	14.97	14.70	14.08	13.77	14.17	13.77	14.00
2000	21.12	21.00	25.37	12.59	12.37	11.85	11.59	11.92	11.59	11.78
2001	18.11	18.00	22.31	10.87	10.68	10.23	10.00	10.29	10.00	10.17
2002	15.81	15.69	19.94	9.56	9.39	9.00	8.79	9.05	8.79	8.94
2003	13.97	13.86	18.05	8.52	8.37	8.02	7.83	8.06	7.83	7.97
2004	12.47	12.36	16.50	7.68	7.54	7.22	7.05	7.26	7.05	7.17
2005	11.22	11.11	15.20	6.98	6.85	6.56	6.40	6.59	6.40	6.51
2006	10.15	10.05	14.09	6.38	6.26	5.99	5.85	6.02	5.85	5.95
2007	9.24	9.14	13.14	5.87	5.76	5.51	5.37	5.54	5.37	5.47
2008	8.45	8.35	12.30	5.43	5.33	5.09	4.96	5.12	4.96	5.05
2009	7.76	7.66	11.57	5.04	4.94	4.72	4.60	4.75	4.60	4.69
2010	7.15	7.05	10.92	4.70	4.61	4.40	4.28	4.42	4.28	4.36
2011	6.61	6.51	10.34	4.39	4.31	4.11	4.00	4.13	4.00	4.08
2012	6.13	6.03	9.81	4.12	4.04	3.85	3.75	3.87	3.75	3.82
2013	5.69	5.60	9.34	3.87	3.80	3.62	3.52	3.64	3.52	3.59
2014	5.30	5.21	8.91	3.65	3.58	3.41	3.31	3.43	3.31	3.38
2015	4.94	4.85	8.52	3.45	3.38	3.22	3.12	3.23	3.12	3.19
2016	4.62	4.53	8.17	3.27	3.20	3.04	2.95	3.06	2.95	3.01
2017	4.32	4.23	7.84	3.10	3.03	2.88	2.80	2.90	2.80	2.86
2018	4.05	3.96	7.53	2.94	2.88	2.74	2.65	2.75	2.65	2.71
2019	3.80	3.71	7.25	2.80	2.74	2.60	2.52	2.61	2.52	2.58
2020	3.57	3.48	6.99	2.67	2.61	2.48	2.40	2.49	2.40	2.45
2021	3.36	3.27	6.75	2.55	2.49	2.36	2.28	2.37	2.28	2.34
2022	3.16	3.08	6.53	2.43	2.38	2.25	2.18	2.26	2.18	2.23
2023	2.98	2.90	6.32	2.33	2.27	2.15	2.08	2.16	2.08	2.13
2024	2.81	2.73	6.12	2.23	2.18	2.06	1.99	2.07	1.99	2.04
2025	2.65	2.57	5.94	2.14	2.09	1.97	1.91	1.98	1.91	1.95
2026	2.50	2.42	5.76	2.05	2.00	1.89	1.83	1.90	1.83	1.87
2027	2.37	2.28	5.60	1.97	1.92	1.81	1.75	1.82	1.75	1.79
2028	2.24	2.16	5.45	1.89	1.85	1.74	1.68	1.75	1.68	1.72
2029	2.11	2.04	5.30	1.82	1.78	1.67	1.61	1.68	1.61	1.65
2030	2.00	1.92	5.16	1.75	1.71	1.61	1.55	1.62	1.55	1.59
2031	1.89	1.82	5.03	1.69	1.65	1.55	1.49	1.56	1.49	1.53
2032	1.79	1.71	4.91	1.63	1.59	1.49	1.44	1.50	1.44	1.47
2033	1.70	1.62	4.79	1.57	1.53	1.44	1.38	1.45	1.38	1.42
2034	1.61	1.53	4.68	1.52	1.48	1.39	1.33	1.40	1.33	1.37
2035	1.52	1.45	4.58	1.47	1.43	1.34	1.29	1.35	1.29	1.32
2036	1.44	1.37	4.48	1.42	1.38	1.29	1.24	1.30	1.24	1.28
2037	1.36	1.29	4.38	1.37	1.34	1.25	1.20	1.26	1.20	1.23

Table D4: Land line scen. - intra. SOAD of unit energy costs for nonres. cons.

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	120.12	122.92	121.20	89.46	99.93	158.72	106.75	98.55	89.46	106.18
1997	92.86	95.50	94.50	67.23	74.82	114.78	79.61	73.84	67.23	80.40
1998	74.06	76.54	76.17	51.82	56.73	85.66	60.29	56.00	51.82	62.85
1999	61.11	63.49	63.68	41.60	44.88	64.27	45.10	44.47	41.60	50.98
2000	51.93	54.30	54.98	34.66	38.56	51.55	35.87	38.07	34.66	42.74
2001	44.92	47.27	48.40	29.51	34.01	44.46	29.51	33.61	29.80	36.55
2002	39.22	41.56	43.08	25.49	30.39	38.99	25.49	30.06	26.87	31.57
2003	34.52	36.84	38.71	23.29	27.47	34.67	23.29	27.19	24.48	27.50
2004	30.57	32.87	35.05	21.46	25.06	31.18	21.46	24.82	22.49	24.12
2005	27.22	29.50	31.96	19.91	23.06	28.31	19.91	22.85	20.82	21.27
2006	24.35	26.61	29.32	18.60	21.37	25.93	18.60	21.18	19.41	18.85
2007	21.87	24.10	27.04	17.47	19.92	23.93	18.18	19.76	18.19	17.47
2008	19.70	21.91	25.05	16.50	18.68	22.22	18.03	18.54	17.14	16.50
2009	17.85	19.98	23.30	15.64	17.61	20.76	17.94	17.48	16.22	15.64
2010	16.95	18.38	21.75	14.89	16.66	19.49	18.72	16.55	15.42	14.89
2011	16.15	17.57	20.37	14.23	15.84	18.39	20.02	15.73	14.71	14.23
2012	15.44	16.84	19.65	13.64	15.11	17.41	21.70	15.01	14.08	13.64
2013	14.80	16.18	19.08	13.12	14.46	16.56	23.30	14.37	13.52	13.12
2014	14.22	15.59	18.57	12.65	13.88	15.80	24.74	13.80	13.01	12.65
2015	13.70	15.06	18.10	12.22	13.36	15.12	26.06	13.28	12.56	12.22
2016	13.23	14.57	17.67	11.84	12.89	14.51	27.26	12.82	12.15	11.84
2017	12.80	14.12	17.28	11.49	12.46	13.96	28.35	12.40	11.78	11.49
2018	12.41	13.71	16.92	11.17	12.08	13.47	29.36	12.02	11.45	11.17
2019	12.05	13.34	16.59	10.88	11.73	13.02	30.29	11.67	11.14	10.88
2020	11.72	12.99	16.28	10.62	11.41	12.61	31.15	11.36	10.86	10.62
2021	11.42	12.67	16.00	10.37	11.11	12.24	31.95	11.07	10.60	10.37
2022	11.14	12.38	15.73	10.15	10.84	11.89	32.69	10.80	10.36	10.15
2023	10.88	12.10	15.48	9.94	10.60	11.58	33.39	10.55	10.14	9.94
2024	10.64	11.85	15.25	9.75	10.37	11.29	34.03	10.33	9.94	9.75
2025	10.41	11.61	15.03	9.57	10.15	11.03	34.64	10.12	9.75	9.57
2026	10.21	11.39	14.83	9.41	9.96	10.78	35.20	9.92	9.58	9.41
2027	10.01	11.18	14.63	9.26	9.78	10.55	35.73	9.74	9.42	9.26
2028	9.83	10.99	14.45	9.11	9.61	10.34	36.23	9.58	9.26	9.11
2029	9.66	10.81	14.28	8.98	9.45	10.15	36.70	9.42	9.12	8.98
2030	9.51	10.63	14.11	8.86	9.30	9.96	37.15	9.27	8.99	8.86
2031	9.36	10.47	13.96	8.74	9.16	9.79	37.57	9.14	8.87	8.74
2032	9.22	10.32	13.81	8.63	9.03	9.63	37.97	9.01	8.75	8.63
2033	9.09	10.18	13.67	8.53	8.91	9.48	38.35	8.89	8.64	8.53
2034	8.97	10.04	13.53	8.43	8.80	9.34	38.70	8.77	8.54	8.43
2035	8.85	9.91	13.40	8.34	8.69	9.21	39.05	8.67	8.45	8.34
2036	8.74	9.79	13.28	8.25	8.59	9.08	39.37	8.57	8.35	8.25
2037	8.64	9.68	13.16	8.17	8.49	8.97	39.68	8.47	8.27	8.17

Table D5: Diesel scenario - inter. SOAD of unit energy costs for res. consumers

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	45.25	45.47	40.51	440.21	412.28	467.18	465.95	351.08	400.36	405.29
1997	41.73	41.93	37.33	408.72	383.58	423.38	424.04	328.00	371.87	376.77
1998	38.57	38.76	34.49	380.06	357.37	385.11	387.16	306.78	345.92	350.75
1999	35.74	35.92	31.95	354.03	333.47	351.63	354.69	287.31	322.33	327.07
2000	33.21	33.37	29.67	330.43	311.75	322.36	326.13	269.49	300.94	305.56
2001	30.94	31.09	27.64	309.09	292.05	296.78	301.02	253.24	281.58	286.08
2002	28.92	29.06	25.83	289.86	274.24	274.45	278.99	238.45	264.13	268.50
2003	27.13	27.26	24.22	272.59	258.20	255.00	259.71	225.07	248.45	252.68
2004	25.53	25.66	22.79	257.15	243.83	238.11	242.88	213.00	234.42	238.52
2005	24.13	24.24	21.53	243.42	231.01	223.48	228.25	202.18	221.94	225.90
2006	22.89	23.00	20.43	231.28	219.66	210.89	215.60	192.54	210.91	214.73
2007	21.82	21.92	19.47	220.64	209.67	200.12	204.74	184.03	201.22	204.92
2008	20.89	20.99	18.64	211.40	200.98	190.98	195.49	176.58	192.81	196.39
2009	20.10	20.20	17.93	203.46	193.50	183.30	187.69	170.13	185.58	189.05
2010	19.43	19.53	17.33	196.74	187.16	176.95	181.22	164.65	179.46	182.84
2011	18.88	18.97	16.84	191.18	181.89	171.79	175.95	160.07	174.39	177.68
2012	18.44	18.53	16.45	186.69	177.63	167.72	171.77	156.35	170.30	173.52
2013	18.10	18.19	16.14	183.21	174.33	164.62	168.59	153.46	167.13	170.29
2014	17.85	17.94	15.92	180.69	171.92	162.41	166.31	151.34	164.82	167.94
2015	17.69	17.78	15.78	179.05	170.37	161.00	164.86	149.97	163.34	166.42
2016	17.62	17.70	15.71	178.26	169.61	160.33	164.16	149.30	162.61	165.69
2017	17.62	17.70	15.71	178.26	169.61	160.33	164.16	149.30	162.61	165.69
2018	17.69	17.77	15.78	179.01	170.33	160.94	164.80	149.93	163.29	166.38
2019	17.83	17.91	15.90	180.45	171.72	162.11	166.02	151.18	164.62	167.73
2020	18.03	18.12	16.08	182.56	173.74	163.79	167.77	153.00	166.54	169.70
2021	18.29	18.38	16.32	185.29	176.37	165.93	170.01	155.38	169.04	172.26
2022	18.61	18.70	16.60	188.61	179.57	168.50	172.70	158.28	172.07	175.37
2023	18.98	19.08	16.93	192.48	183.31	171.46	175.81	161.68	175.61	179.00
2024	19.41	19.50	17.30	196.87	187.56	174.78	179.30	165.56	179.63	183.12
2025	19.87	19.97	17.72	201.76	192.30	178.43	183.15	169.89	184.10	187.72
2026	20.39	20.49	18.18	207.11	197.49	182.37	187.31	174.66	189.01	192.75
2027	20.94	21.04	18.67	212.90	203.12	186.60	191.78	179.84	194.31	198.20
2028	21.54	21.64	19.20	219.11	209.16	191.07	196.52	185.42	200.00	204.05
2029	22.17	22.28	19.76	225.71	215.59	195.78	201.51	191.37	206.04	210.27
2030	22.84	22.95	20.35	232.68	222.39	200.70	206.74	197.69	212.43	216.84
2031	23.54	23.65	20.97	240.00	229.54	205.82	212.18	204.34	219.14	223.75
2032	24.27	24.39	21.62	247.65	237.02	211.12	217.82	211.32	226.16	230.98
2033	25.04	25.16	22.30	255.61	244.82	216.59	223.64	218.62	233.46	238.51
2034	25.83	25.95	23.00	263.87	252.91	222.20	229.63	226.21	241.04	246.33
2035	26.65	26.77	23.73	272.41	261.29	227.95	235.77	234.09	248.87	254.41
2036	27.49	27.62	24.48	281.21	269.93	233.83	242.06	242.25	256.95	262.75
2037	28.36	28.50	25.25	290.27	278.83	239.83	248.48	250.66	265.26	271.33
GINI	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table D6: Diesel scenario - intertemporal SOAD of unit energy costs for nonres. cons.

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	238	256	227	15006	15093	15666	15536	15069	15133	14914
1997	245	263	238	15002	15091	15656	15530	15065	15128	14912
1998	252	269	248	14999	15089	15647	15523	15061	15123	14909
1999	258	275	257	14995	15087	15639	15518	15058	15119	14907
2000	264	281	265	14992	15085	15631	15512	15054	15115	14905
2001	269	286	272	14988	15083	15623	15506	15050	15111	14903
2002	274	291	279	14985	15081	15616	15501	15047	15107	14901
2003	279	295	286	14982	15080	15609	15496	15043	15104	14899
2004	283	300	292	14979	15078	15602	15492	15040	15100	14898
2005	287	304	297	14977	15076	15596	15487	15037	15097	14896
2006	291	308	302	14974	15074	15590	15483	15034	15094	14894
2007	295	311	307	14972	15073	15585	15479	15030	15091	14893
2008	298	315	311	14969	15071	15579	15475	15027	15088	14891
2009	302	318	316	14967	15070	15574	15471	15024	15085	14890
2010	305	321	319	14964	15068	15569	15467	15021	15082	14889
2011	308	324	323	14962	15067	15564	15464	15018	15080	14887
2012	311	326	327	14960	15065	15560	15460	15015	15077	14886
2013	314	329	330	14958	15064	15555	15457	15013	15075	14885
2014	317	332	333	14956	15063	15551	15454	15010	15072	14884
2015	319	334	336	14954	15061	15547	15451	15007	15070	14882
2016	322	336	338	14952	15060	15543	15448	15004	15068	14881
2017	324	338	341	14950	15059	15539	15445	15002	15066	14880
2018	326	341	343	14948	15057	15535	15442	14999	15063	14879
2019	328	343	346	14947	15056	15532	15439	14997	15061	14878
2020	331	345	348	14945	15055	15528	15436	14994	15059	14877
2021	333	346	350	14943	15054	15525	15434	14992	15057	14876
2022	334	348	352	14942	15052	15522	15431	14989	15056	14875
2023	336	350	354	14940	15051	15519	15429	14987	15054	14875
2024	338	351	356	14939	15050	15515	15427	14984	15052	14874
2025	340	353	357	14937	15049	15512	15424	14982	15050	14873
2026	342	355	359	14936	15048	15510	15422	14980	15048	14872
2027	343	356	361	14934	15047	15507	15420	14978	15047	14871
2028	345	357	362	14933	15046	15504	15418	14976	15045	14870
2029	346	359	364	14932	15045	15501	15416	14973	15044	14870
2030	348	360	365	14930	15044	15499	15414	14971	15042	14869
2031	349	361	366	14929	15043	15496	15412	14969	15040	14868
2032	350	363	368	14928	15042	15494	15410	14967	15039	14868
2033	352	364	369	14926	15041	15491	15408	14965	15038	14867
2034	353	365	370	14925	15040	15489	15406	14963	15036	14866
2035	354	366	371	14924	15039	15487	15404	14961	15035	14866
2036	356	367	372	14923	15038	15485	15402	14959	15033	14865
2037	357	368	373	14922	15037	15482	15401	14957	15032	14864
GINI	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table D7: Land line scenario - intertemporal SOAD of unit energy costs for res. cons.

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	45.25	45.47	40.51	229.80	241.31	164.33	165.22	279.69	213.94	226.44
1997	41.73	41.93	37.33	644.02	658.93	257.54	298.51	685.74	579.42	616.07
1998	38.57	38.76	34.49	722.11	736.26	312.43	356.21	761.04	651.27	690.45
1999	35.74	35.92	31.95	766.56	780.35	345.14	390.39	804.12	692.64	733.07
2000	33.21	33.37	29.67	796.97	810.52	368.17	414.36	833.68	721.14	762.35
2001	30.94	31.09	27.64	819.71	833.11	385.75	432.61	855.84	742.56	784.32
2002	28.92	29.06	25.83	837.67	850.96	399.86	447.22	873.37	759.55	801.70
2003	27.13	27.26	24.22	852.39	865.58	411.56	459.32	887.75	773.51	815.97
2004	25.53	25.66	22.79	864.76	877.88	421.51	469.59	899.86	785.28	827.99
2005	24.13	24.24	21.53	875.38	888.44	430.13	478.48	910.26	795.40	838.32
2006	22.89	23.00	20.43	884.64	897.65	437.70	486.28	919.34	804.24	847.33
2007	21.82	21.92	19.47	892.82	905.79	444.44	493.21	927.36	812.06	855.30
2008	20.89	20.99	18.64	900.11	913.05	450.48	499.42	934.52	819.05	862.41
2009	20.10	20.20	17.93	906.68	919.58	455.96	505.04	940.97	825.35	868.82
2010	19.43	19.53	17.33	912.64	925.51	460.95	510.17	946.82	831.07	874.64
2011	18.88	18.97	16.84	918.08	930.93	465.53	514.86	952.17	836.30	879.96
2012	18.44	18.53	16.45	923.07	935.90	469.75	519.19	957.08	841.11	884.84
2013	18.10	18.19	16.14	927.68	940.49	473.66	523.20	961.62	845.55	889.35
2014	17.85	17.94	15.92	931.95	944.75	477.30	526.92	965.83	849.67	893.54
2015	17.69	17.78	15.78	935.93	948.71	480.70	530.40	969.74	853.50	897.43
2016	17.62	17.70	15.71	939.64	952.40	483.88	533.66	973.40	857.09	901.07
2017	17.62	17.70	15.71	943.12	955.87	486.87	536.72	976.83	860.45	904.48
2018	17.69	17.77	15.78	946.39	959.13	489.69	539.60	980.05	863.61	907.69
2019	17.83	17.91	15.90	949.47	962.19	492.35	542.32	983.09	866.59	910.71
2020	18.03	18.12	16.08	952.38	965.09	494.87	544.89	985.95	869.41	913.56
2021	18.29	18.38	16.32	955.14	967.84	497.26	547.34	988.67	872.08	916.27
2022	18.61	18.70	16.60	957.75	970.44	499.54	549.66	991.25	874.61	918.83
2023	18.98	19.08	16.93	960.23	972.91	501.70	551.87	993.70	877.02	921.27
2024	19.41	19.50	17.30	962.60	975.27	503.77	553.98	996.03	879.31	923.59
2025	19.87	19.97	17.72	964.85	977.52	505.74	555.99	998.26	881.50	925.81
2026	20.39	20.49	18.18	967.01	979.66	507.63	557.92	1000.38	883.59	927.93
2027	20.94	21.04	18.67	969.07	981.72	509.44	559.76	1002.42	885.59	929.95
2028	21.54	21.64	19.20	971.04	983.68	511.18	561.53	1004.37	887.50	931.89
2029	22.17	22.28	19.76	972.93	985.57	512.85	563.23	1006.23	889.34	933.75
2030	22.84	22.95	20.35	974.75	987.38	514.45	564.87	1008.03	891.11	935.54
2031	23.54	23.65	20.97	976.50	989.12	516.00	566.44	1009.76	892.81	937.26
2032	24.27	24.39	21.62	978.18	990.80	517.49	567.95	1011.42	894.45	938.91
2033	25.04	25.16	22.30	979.80	992.41	518.92	569.42	1013.02	896.02	940.51
2034	25.83	25.95	23.00	981.36	993.97	520.31	570.83	1014.56	897.54	942.05
2035	26.65	26.77	23.73	982.86	995.47	521.65	572.19	1016.05	899.01	943.53
2036	27.49	27.62	24.48	984.32	996.92	522.95	573.51	1017.49	900.43	944.96
2037	28.36	28.50	25.25	985.73	998.33	524.20	574.79	1018.88	901.80	946.35
GINI	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table D8: Land line scenario - inter. SOAD of unit energy costs for nonres. cons.

YEAR	Cross Lake	Nelson House	Split Lake	Oxford House	Gods Lake	Gods River	Red Sucker Lake	Garden Hill	St. Theresa Point	Wasa-gamack
1996	238.49	255.79	227.16	706.81	370.89	432.74	200.85	405.45	478.24	1017.47
1997	245.41	262.76	237.90	803.65	575.22	206.86	170.86	605.54	626.27	1039.86
1998	251.87	269.21	247.67	868.25	723.53	162.06	268.98	751.23	720.87	1059.52
1999	257.90	275.21	256.60	920.25	818.47	235.16	387.22	842.80	784.89	1076.91
2000	263.55	280.79	264.79	963.02	882.57	333.06	479.50	906.03	836.47	1092.41
2001	268.85	285.99	272.32	998.82	934.22	398.00	553.51	957.04	878.93	1106.30
2002	273.84	290.86	279.25	1029.21	976.73	450.25	614.19	999.07	914.48	1118.84
2003	278.53	295.43	285.66	1055.35	1012.32	493.20	664.84	1034.30	944.69	1130.19
2004	282.97	299.72	291.59	1078.05	1042.55	529.14	707.77	1064.25	970.67	1140.54
2005	287.16	303.75	297.09	1097.97	1068.56	559.64	744.61	1090.03	993.26	1150.00
2006	291.12	307.56	302.21	1115.58	1091.16	585.86	776.57	1112.45	1013.07	1158.68
2007	294.89	311.15	306.97	1131.25	1110.99	608.64	804.56	1132.13	1030.60	1166.67
2008	298.46	314.55	311.43	1145.31	1128.53	628.61	829.28	1149.54	1046.20	1174.06
2009	301.85	317.77	315.59	1157.97	1144.15	646.27	851.27	1165.06	1060.20	1180.92
2010	305.09	320.83	319.49	1169.44	1158.15	661.99	870.95	1178.97	1072.81	1187.28
2011	308.17	323.73	323.15	1179.88	1170.77	676.07	888.68	1191.51	1084.24	1193.22
2012	311.11	326.49	326.58	1189.43	1182.21	688.76	904.73	1202.88	1094.64	1198.76
2013	313.91	329.12	329.82	1198.19	1192.62	700.26	919.33	1213.23	1104.15	1203.95
2014	316.60	331.63	332.87	1206.25	1202.13	710.73	932.66	1222.70	1112.88	1208.82
2015	319.16	334.02	335.74	1213.70	1210.87	720.29	944.89	1231.39	1120.92	1213.39
2016	321.62	336.31	338.46	1220.60	1218.91	729.06	956.14	1239.39	1128.35	1217.70
2017	323.98	338.49	341.03	1227.02	1226.34	737.14	966.53	1246.78	1135.23	1221.77
2018	326.25	340.59	343.47	1232.99	1233.23	744.61	976.15	1253.64	1141.63	1225.61
2019	328.42	342.59	345.78	1238.58	1239.62	751.52	985.09	1260.01	1147.59	1229.25
2020	330.51	344.52	347.97	1243.80	1245.59	757.95	993.42	1265.95	1153.15	1232.70
2021	332.52	346.37	350.06	1248.70	1251.16	763.93	1001.19	1271.49	1158.36	1235.97
2022	334.46	348.14	352.04	1253.31	1256.37	769.52	1008.46	1276.69	1163.25	1239.08
2023	336.32	349.85	353.92	1257.64	1261.26	774.75	1015.28	1281.56	1167.85	1242.04
2024	338.12	351.49	355.72	1261.73	1265.86	779.66	1021.69	1286.14	1172.17	1244.86
2025	339.85	353.07	357.44	1265.60	1270.18	784.27	1027.72	1290.45	1176.25	1247.55
2026	341.53	354.60	359.07	1269.26	1274.27	788.62	1033.41	1294.52	1180.11	1250.12
2027	343.14	356.07	360.64	1272.72	1278.12	792.71	1038.78	1298.36	1183.76	1252.58
2028	344.71	357.48	362.13	1276.01	1281.78	796.58	1043.86	1302.00	1187.22	1254.93
2029	346.22	358.85	363.57	1279.14	1285.24	800.24	1048.68	1305.45	1190.50	1257.18
2030	347.68	360.17	364.94	1282.11	1288.52	803.72	1053.25	1308.73	1193.62	1259.33
2031	349.09	361.45	366.25	1284.95	1291.64	807.01	1057.59	1311.84	1196.59	1261.40
2032	350.46	362.69	367.51	1287.65	1294.61	810.14	1061.72	1314.80	1199.42	1263.39
2033	351.79	363.89	368.72	1290.23	1297.44	813.12	1065.65	1317.62	1202.12	1265.30
2034	353.08	365.05	369.88	1292.70	1300.14	815.95	1069.41	1320.31	1204.70	1267.14
2035	354.33	366.17	371.00	1295.06	1302.72	818.66	1072.99	1322.88	1207.16	1268.91
2036	355.54	367.26	372.07	1297.32	1305.18	821.24	1076.41	1325.34	1209.51	1270.61
2037	356.72	368.31	373.10	1299.49	1307.54	823.71	1079.69	1327.69	1211.77	1272.25
GINI	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table D9: Intratemporal distributive fairness measure magnitudes

	Diesel Alternative		Land Line Alternative	
YEAR	Residential	Non residential	Residential	Non residential
1996	0.10	0.26	0.06	0.10
1997	0.10	0.26	0.03	0.08
1998	0.10	0.26	0.02	0.06
1999	0.10	0.26	0.02	0.05
2000	0.09	0.26	0.01	0.04
2001	0.09	0.26	0.01	0.04
2002	0.09	0.26	0.01	0.03
2003	0.09	0.26	0.01	0.03
2004	0.09	0.26	0.01	0.03
2005	0.09	0.26	0.01	0.03
2006	0.09	0.26	0.01	0.02
2007	0.09	0.26	0.01	0.02
2008	0.09	0.26	0.01	0.02
2009	0.09	0.26	0.01	0.02
2010	0.09	0.26	0.01	0.02
2011	0.09	0.26	0.01	0.02
2012	0.08	0.26	0.00	0.02
2013	0.08	0.26	0.00	0.02
2014	0.08	0.26	0.00	0.02
2015	0.08	0.26	0.00	0.02
2016	0.08	0.26	0.00	0.02
2017	0.08	0.26	0.00	0.02
2018	0.08	0.26	0.00	0.02
2019	0.08	0.26	0.00	0.02
2020	0.08	0.26	0.00	0.02
2021	0.08	0.26	0.00	0.02
2022	0.08	0.26	0.00	0.02
2023	0.08	0.26	0.00	0.02
2024	0.08	0.26	0.00	0.02
2025	0.07	0.26	0.00	0.02
2026	0.07	0.26	0.00	0.02
2027	0.07	0.26	0.00	0.01
2028	0.07	0.26	0.00	0.01
2029	0.07	0.26	0.00	0.01
2030	0.07	0.26	0.00	0.01
2031	0.07	0.26	0.00	0.01
2032	0.07	0.26	0.00	0.01
2033	0.07	0.26	0.00	0.01
2034	0.07	0.26	0.00	0.01
2035	0.07	0.26	0.00	0.01
2036	0.07	0.26	0.00	0.01
2037	0.07	0.26	0.00	0.01
AVERAGE	0.08	0.26	0.01	0.02

Table D10: Intertemporal distributive fairness measure magnitudes

	Diesel Alternative		Land Line Alternative	
COMMUNITY	Residential	Non residential	Residential	Non residential
Cross Lake	0.01	0.01	0.01	0.01
Nelson House	0.01	0.01	0.01	0.01
Split Lake	0.01	0.01	0.01	0.01
Oxford House	0.01	0.01	0.01	0.01
Gods Lake	0.01	0.01	0.01	0.01
Gods River	0.01	0.01	0.01	0.01
Red Sucker Lake	0.01	0.01	0.01	0.01
Garden Hill	0.01	0.01	0.01	0.01
St. Theresa Point	0.01	0.01	0.01	0.01
Wasagamack	0.01	0.01	0.01	0.01
AVERAGE	0.01	0.01	0.01	0.01