2 Cost Effectiveness

SUMMARY

Based on the benefit-cost information reported by Minnesota's investor-owned utilities, the Conservation Improvement Program (CIP) has been cost effective. In 2003, CIP's societal benefits were two or three times greater than its societal costs. While we did find problems with the accuracy of these estimates, the problems do not undermine the overall conclusion that CIP has been cost effective. In fact, the utility estimates tended to understate the cost effectiveness of the program, especially for natural gas projects. The Department of Commerce needs to work with the utilities to ensure that they are using appropriate and consistent methodologies and assumptions to measure the effectiveness of CIP.

CIP does not appear to be becoming less effective over time. The cost effectiveness of CIP has remained relatively constant over the last several years. In addition, utilities that have tried to estimate the potential for cost-effective conservation in Minnesota have found that the state should not run out of conservation opportunities in the near future.

Because it is mandated by law, the state has an obligation to oversee utility conservation efforts.

As we discussed in Chapter 1, Minnesota's utilities devoted roughly $91 million to CIP in 2003. While state tax dollars do not pay for the program, the state still has an obligation to ensure that the utilities spend the money effectively. First, CIP is a creation of the state. State law mandates that utilities devote a portion of their revenues for conservation. The utilities recover these conservation funds from their customers by charging more for electricity and natural gas. Second, with respect to the investor-owned utilities, which are monopolies in their service territories, the state has a regulatory responsibility to ensure that the utilities serve their customers effectively. In this chapter, we address the following questions:

- **How do utilities and the Department of Commerce measure the cost-effectiveness of CIP?**
- **How cost effective is CIP?**
- **Are the assumptions and methods that utilities use to calculate the benefits and costs of their CIP activities reasonable and appropriate?**
- **Is CIP experiencing diminishing returns because the most cost-effective conservation activities have already been carried out?**

To answer these questions, we examined the cost effectiveness of CIP in calendar year 2003, the most recent year for which actual program results were available. We obtained not only the benefit-cost figures that the investor-owned utilities computed but also the underlying inputs and assumptions that went into these calculations. We used this information to report the cost-effectiveness of CIP on a statewide basis and assess the accuracy and reasonableness of the utilities' calculations. We only examined the benefit-cost figures of the investor-owned utilities because the municipal and cooperative utilities are not required to compute and report benefit-cost figures.

Because assessing the accuracy and reasonableness of the more technical assumptions is outside the expertise of our staff, we hired two consulting firms—the American Council for an Energy-Efficient Economy (ACEEE) of Washington, D.C. and Synapse Energy Economics of Cambridge, Massachusetts—to assist in our review. Synapse examined the assumptions and methodologies that the electric utilities used to estimate the dollar value associated with the benefits of not having to construct new power plants, transmission lines, and distribution systems. ACEEE examined the electric utilities' estimates of kilowatt-hour and kilowatt savings created by CIP. ACEEE also examined the natural gas utilities' estimates of energy savings.

In the first part of this chapter, we discuss the various benefit-cost measures used by the utilities and the Department of Commerce. In the second part, we discuss the benefit-cost figures that the investor-owned utilities reported to the Department of Commerce in their 2003 status reports. We then briefly discuss some of the problems that we found in the assumptions and methods that the investor-owned utilities used to calculate their benefit-cost figures. Finally, in the last part, we examine whether there is strong evidence that CIP has become less effective over time and whether the state can expect CIP to provide cost-effective conservation in the future.

MEASURES OF COST-EFFECTIVENESS

The utilities and Department of Commerce examine cost effectiveness from four perspectives—societal, utility, program participant, and ratepayer.

Like many states and utilities around the country, the Department of Commerce and Minnesota's utilities measure the cost-effectiveness of conservation programs from four different perspectives—societal, utility, program participant, and ratepayer.[1] Table 2.1 provides a brief definition of each test. Table 2.2 shows the specific benefit-cost factors that are included in each test. The results of the tests are often expressed as a ratio of the benefits to the costs.

Benefit-cost ratios are typically based on benefits that will be received and costs that will be incurred over a 10 to 20 year period. For example, a program participant typically incurs the cost of buying an energy-efficient product in the first year of the project, and the utility incurs the cost of administering this conservation effort in the first year as well. However, once the energy-efficient

1 The California Public Utilities Commission and the California Energy Commission developed a manual for carrying out these tests, which are used widely around the country. California Public Utilities Commission and California Energy Commission, *Standard Practices Manual: Economic Analysis of Demand-Side Management Programs* (December 1987); and California Public Utilities Commission and California Energy Commission, *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects* (October 2001). The manual also discusses a fifth test (the Total Resources test), which is similar to the societal test. Minnesota focuses on the societal test rather than the total resources test.

Table 2.1: Definitions of Cost-Effectiveness Tests

- The **societal test** examines the net impact that a conservation program or project has on society overall. The test combines the impact on the utility, program participants, and non-participating ratepayers. It also includes environmental benefits.
- The **utility test** (also referred to as the "revenue requirements" test) compares the funds that a utility would need to carry out two alternative strategies to meet its customers' energy needs. Under the first approach, the utility sponsors and funds CIP. Under the alternative strategy, the utility provides the same amount of energy as would be conserved through CIP.
- The **participant test** examines the impact of CIP on program participants by comparing their cost of investing in an energy-efficient product with the benefit of having lower energy bills.
- The **ratepayer test** (also referred to as the "cost comparison" test) examines the impact that a CIP project will have on the electric and natural gas rates paid by customers who do not participate in the conservation project.

SOURCE: Office of the Legislative Auditor, based on information in the California Public Utilities Commission and California Energy Commission, *Standard Practice Manual: Economic Analysis of Demand Side-Management Programs* (December 1987).

product is in place, society will receive the benefits of conservation for as long as the product is operating. Typically, energy–efficient appliances have an expected life of about 15 years. Consequently, when computing the benefit-cost ratios, the utilities examine the stream of benefits and costs that will occur over the entire project life.

The Department of Commerce relies heavily on the societal perspective to assess conservation projects.

When reviewing and assessing each utility's overall conservation program and individual projects, the Department of Commerce relies heavily on the societal test. With the exception of projects targeted exclusively for low-income households and projects that have an indirect impact on energy savings (such as energy audits and research & development), the department generally requires projects to have societal benefits that outweigh its societal costs. The department's emphasis on the societal test is appropriate because the department has the goal of serving the overall public interest—not the interest of one particular segment of society, such as utilities, program participants, or other ratepayers.

The "utility test" is somewhat of a misnomer. It does not show the impact of conservation on the utilities for two reasons. First, the test just compares the funds that utilities will need to carry out conservation with the funds that they will need to produce or provide an equivalent amount of energy. It does not include the loss of revenues that utilities will experience by selling less energy because of conservation. Second, the model on which the cost-effectiveness tests are based assumes that utilities will pass the costs and benefits of conservation (including lost revenues) onto their customers/ratepayers by raising or lowering the electric and natural gas rates that they charge. Thus, the ratepayer test (which includes the utilities' lost revenues) actually measures the impact of CIP on the utilities before they pass these benefits and costs onto their ratepayers. From this perspective, and as shown in Table 2.2, the societal test is really a combination of the participant and ratepayer tests with environmental factors also included. The

Table 2.2: Benefit-Cost Factors for the Four Cost-Effectiveness Tests

	Cost-Effectiveness Tests			
Benefit-Cost Factors	Societal	Participant	Ratepayer[a]	Utility
Avoided energy costs (from buying less fuel and reducing the amount of operation and maintenance of power plants, transmission lines, and distribution systems)	Benefit		Benefit	Benefit
Avoided capacity costs (from building/installing fewer power plants, pipelines, transmission lines, and distribution systems)	Benefit		Benefit	Benefit
Avoided environmental damage (including smog, acid rain, and global warming)	Benefit			
Lower energy bills / lost utility revenue (from lower energy consumption and sales)	Transfer between parties[b]	Benefit	Cost	
Rebates and other financial incentives for purchasing high efficiency products	Transfer between parties[c]	Benefit	Cost	Cost
Utilities' cost of administering the conservation programs (excluding the cost of paying rebates and other financial incentives)	Cost		Cost	Cost
Participants' incremental cost of purchasing the high-efficiency product (price difference between the high-efficiency product and product that would have been purchased without CIP)	Cost	Cost		

[a]These costs and benefits are incurred by the utilities, but the model on which this test is based assumes that the utilities pass these costs and benefits onto their customers/ratepayers by decreasing or increasing the electric and natural gas rates that they charge.

[b]CIP lowers the energy bills of program participants, which is a benefit to the participants, but also lowers utilities' revenues by an equivalent amount, which is a cost to the utilities (and eventually ratepayers). Because this is just a transfer from one part of society to another, it is not included in the societal benefit-cost calculation.

[c]The utilities pay rebates to program participants for purchasing high-efficiency products. These rebates are a cost to the utilities (and eventually ratepayers) but a benefit to the program participants. Because this is just a transfer from one part of society to another, it is not included in the societal benefit-cost calculation.

SOURCE: Office of the Legislative Auditor, based on information in California Public Utilities Commission and California Energy Commission, *Standard Practices Manual: Economic Analysis of Demand-Side Management Programs* (December 1987).

utility test is a separate test that compares the funding requirements of conservation versus production.

UTILITY ESTIMATES

When we examined the cost-effectiveness of CIP, we found that:

- **According to the benefit-cost analyses carried out by Minnesota's eight investor-owned utilities, CIP was cost effective in 2003.**

Tables 2.3 and 2.4 show the benefit-cost ratios for each of Minnesota's investor-owned utilities. Overall, CIP benefits society as a whole because the societal benefit-cost ratios are greater than 1.0. However, CIP makes some utilities' customers/ratepayers who do not purchase energy-efficient products and receive rebates worse off. The ratepayers' benefit-cost ratios for the electric projects are sometimes below 1.0, reflecting that these customers will have to pay higher electric rates because of CIP. Furthermore, as we will discuss in greater detail in the next section, the ratepayer ratios for the natural gas utilities are too high because of methodological errors in calculating them. After making the necessary corrections, we recalculated the ratios to be less than 1.0 for all the gas utilities. While ratepayers who do not participate in CIP will have to pay higher energy bills because of CIP, ratepayers who participate in CIP and society as a whole will benefit because the participant and societal tests are greater than 1.0.

In 2003, CIP's societal benefits were two or three times greater than its societal costs.

Table 2.3: Utility Reported Benefit-Cost Ratios for Electric Conservation, 2003

Utility	Societal Test	Utility Test	Participant Test	Ratepayer Test
Interstate Power & Light	2.6	4.5	1.8	0.8
Minnesota Power	2.3	6.1	3.5	0.8
Otter Tail Power	3.1	6.5	3.8	0.9
Xcel Energy	3.0	5.4	4.7	1.1
Investor-Own Utilities Total	2.9	5.4	4.0	1.0

SOURCE: Investor-owned utilities' benefit-cost data from 2003 status reports.

Table 2.4: Utility Reported Benefit-Cost Ratios for Natural Gas Conservation, 2003

Utility	Societal Test	Utility Test	Participant Test	Ratepayer Test
CenterPoint Energy Minnegasco	1.8	5.1	2.8	2.0
Great Plains Natural Gas	4.2	6.6	7.6	1.6
Interstate Power & Light	2.0			
Northern Minnesota Utilities	1.5	2.3	2.9	1.3
Peoples Natural Gas	1.8	2.9	2.5	2.8
Xcel Energy	3.8	6.8	6.9	1.6
Investor-Own Utilities Total	2.3	5.3	3.7	1.8

SOURCE: Investor-owned utilities' benefit-cost data from 2003 status reports.

Based on the results in Tables 2.3 and 2.4, we cannot determine which utility is doing a better job of carrying out conservation programs. First, as we will discuss later, there are inconsistencies and variations in the assumptions and methodologies that utilities use to compute their benefit-cost ratios. Thus, the ratios are not directly comparable but provide a general indication of the cost-effectiveness of CIP. Second, the service areas and market situations of each utility are different, which affects the utilities' ability to provide cost-effective conservation. For example, one utility may have a higher proportion of commercial and industrial customers, which generally have better conservation opportunities than residential customers. Another utility may have a rural service area. These areas may have a limited number of vendors and contractors who provide energy-efficient products or conservations services. In addition, a dispersed population makes it difficult for utilities to provide conservation services.

Having four different cost-effectiveness tests can create confusion.

While having four separate cost-effectiveness tests allows the Department of Commerce and the utilities to examine the effects of conservation projects from different perspectives, it can also create some confusion. For example, when the 2003 Legislature was considering proposals to use a portion of CIP funds for renewable energy projects, the Department of Commerce stated that electric utilities avoid seven dollars in energy and capacity costs for every dollar utilities spend on CIP. Some legislators have questioned whether this seven-to-one benefit-cost ratio is accurate when they have seen benefit-cost ratios closer to two-to-one or three-to-one.

One reason for this apparent inconsistency is that the department based its seven-to-one ratio on the utility test while most people, including the department, typically focus on the societal test when evaluating CIP programs. As Tables 2.3 and 2.4 show, the societal test usually has a lower benefit-cost ratio than the utility test. The department used the utility test in this case because it was comparing alternative ways of meeting state energy needs (energy conservation versus renewable energy projects). The utility test is often used by state agencies in energy planning to identify the alternative with the lowest cost to the utility. Nevertheless, we think that when discussing CIP as a way to meet energy needs, the department should present both tests. The societal test is useful because it takes a broader perspective than the utility test and is commonly used to present CIP results. In the future, presenting both tests and explaining the difference could help avoid confusion.

Another reason for the discrepancy is that the seven-to-one ratio was based on dated information. Specifically, it was based on the utility test for Xcel Energy's 2001 electric CIP. At the time of the legislative hearings, this was Xcel's most recent utility benefit-cost ratio that had been approved by the department. However, Xcel's 2003 status report showed that its utility benefit cost ratio declined from 7.5 to 5.4. In large part, Xcel's benefit-cost ratio declined because it revised how it determined its avoided capacity costs.

ASSESSMENT OF UTILITY METHODS

Accurately measuring the benefits and costs of CIP is important for two reasons. First, benefit-cost measures tell decision makers how well the program is performing and whether or not performance is improving. Second, utilities and the Department of Commerce use these measures to monitor the performance of individual projects so that they can make better decisions about which projects to cut back, continue, or expand.

To access the reasonableness of the utility's benefit-cost calculations, we reviewed and assessed 12 factors that go into the calculations. We identified the 12 factors by reviewing literature that discusses the cost-effectiveness tests, interviewing utilities and other stakeholders, and analyzing and assessing the benefit-cost calculations from Minnesota's utilities. To be part of our review, a factor had to be (1) a primary driver of the benefit-cost results, (2) hard to measure or particularly uncertain, or (3) a known problem. The 12 factors are listed in Table 2.5. We asked the consultants that we hired to examine the first five factors, and we examined the last seven.

Overall, we found that:

- **The methods and assumptions used by the utilities to calculate the benefits and costs of CIP projects have several problems, but the problems do not undermine the overall conclusion that CIP is cost effective.**

Table 2.5: Factors in Benefit-Cost Calculations That Were Reviewed

- **Energy savings calculations** are the estimates of the kilowatt-hours or Mcf of energy saved through CIP.
- **Capacity savings calculations** (electric only) are the estimates of the kilowatts of capacity saved through CIP.
- **Avoided energy costs** (electric only) are the estimated monetary value of the energy savings achieved by CIP. The estimates reflect the costs that utilities avoid by (1) purchasing less fuel and (2) reducing the operation and maintenance of their power plants, transmission lines, and distribution systems. The estimates are expressed in avoided costs per kilowatt-hour saved.
- **Avoided capacity costs** (electric only) are the estimated monetary value of the capacity savings achieved by CIP. The estimates reflect the costs that the utilities avoid by delaying the construction of power plants, transmission lines, and distribution systems. The estimates are expressed in avoided costs per kilowatt saved.
- **Free-rider / free-driver effects** are indirect market factors that affect the amount of energy savings that should be attributed to CIP. Free-riders are individuals or businesses that purchase energy-efficient products and receive rebates but would have purchased the products on their own without CIP or the rebates. Free-drivers are individuals or businesses that purchase an energy-efficient product because of CIP but do not apply for a rebate. For example, a CIP advertising promotion may lead an individual to buy an energy-efficient furnace, but for some reason the individual does not apply for a rebate.
- **Avoided environmental damage costs** are the estimated monetary value of the environmental damages that CIP avoided. The savings are expressed in avoided costs per kilowatt-hour or Mcf saved.
- **Natural gas prices** are the cost of natural gas to the utilities. These prices are the primary monetary value of the energy and capacity savings created by CIP gas projects.
- **Discount rates** are the rate at which future benefits and costs are discounted to reflect their value today. Because conservation benefits may last for 10 to 20 years, the value of these benefits need to be discounted to reflect the fact that a dollar received in the future is less valuable than a dollar received today.
- **Project lives** are the number of years that energy-efficient products operate and conserve energy.
- **Structural errors in the Department of Commerce's benefit-cost model for natural gas** reflect discrepancies in how the department's model computes benefits and costs with how a nationally recognized model computes them.
- **Misclassification of a program benefit** reflects a structure problem in one of the utilities' benefit cost calculations.
- **Utility incentive payments** are the rewards that utilities receive for meeting or exceeding their energy savings goals. While ratepayers finance these payments by paying higher energy rates, these costs are not included in the ratepayer test.

SOURCE: Office of the Legislative Auditor.

The types of problems we found include (1) out-of-date information, (2) inconsistencies between utilities in how they measure costs and benefits, (3) structural problems with the benefit-cost model used by gas utilities, and (4) problems that distort the relative performance of projects within utilities.

The impact of these problems varies among utilities and among individual projects. Overall, the problems we identified appear to understate the effectiveness of the 2003 conservation projects more often than they overstate the effectiveness, particularly for gas utilities. Table 2.6 summarizes the type of problems we identified and indicates whether they understate or overstate the program's effectiveness under each of the four benefit-cost tests. For some of these problems, we made corrections and estimated the impact on the benefit-cost

On balance, problems in the utilities' benefit-cost calculations tended to understate CIP's effectiveness.

Table 2.6: Types of Problems in the 2003 Benefit-Cost Calculations

	Effect of the Problem on the 2003 Benefit-Cost Ratios			
Problem	Societal Test	Utility Test	Participant Test	Ratepayer Test
Out-of-date assumptions				
Natural gas prices	Understates	Understates	Understates	Mixed
Discount rates (gas and electric)	Understates	Not examined	Not examined	Not examined
Inconsistencies				
Societal discount rates for electric utilities (Xcel and Otter Tail)	Understates	No effect	No effect	No effect
Avoided costs of energy and power plants (electric)	Mixed	Mixed	No effect	Mixed
Avoided costs of transmission and distribution (electric)	Mixed	Mixed	No effect	Mixed
Avoided costs of environmental damage (electric)	Mixed	No effect	No effect	No effect
Structural problems				
Errors in the benefit-cost model for natural gas	Understates	No effect	Understates	Overstates
Treatment of incentive payments for utilities (gas and electric)	No effect	No effect	No effect	Overstates
Distortion problems				
Categorization of costs and benefits (Xcel electric)	Overstates	No effect	Overstates	No effect
Project lives (gas)	Mixed	Mixed	Mixed	Mixed

SOURCE: Office of the Legislative Auditor.

ratios, which we discuss in the following sections. For other problems, we could not estimate the size of the problem precisely enough to make a correction. While we were not able to correct all of the problems we identified, these uncorrected problems should not undermine the overall conclusion that CIP is cost effective for several reasons. First, correcting for the problems we could accurately quantify increased the benefit-cost ratios for the societal test—the primary test used to assess the program's overall effectiveness. Second, some of the uncorrected problems make the ratios too high, while others make the ratios too low. Finally, the reported ratios were well above 1.0. It would take large errors that systematically overstate the benefit-cost ratios to undermine our conclusion.

The only benefit-cost ratio that appears to systematically overstate the program's effectiveness is the ratepayer ratio for gas utilities. After correcting the problems that we could quantify, we recalculated the ratio for gas utilities to be less than 1.0, rather than the 1.8 reported by utilities. As we mentioned earlier, the Department of Commerce does not require a ratepayer ratio for a conservation project to be greater than 1.0 in order to be approved.

Out-of-Date Information

Natural gas prices are a key input for benefit-cost calculations because the value of the gas that is conserved is the main benefit of gas conservation projects. However, we found that:

- **The use of out-of-date natural gas prices resulted in a significant understatement of the 2003 benefit-cost ratios for the natural gas utilities.**

If the utilities had used up-to-date natural gas prices, the 2003 societal benefit-cost ratios would have been about 48 percent higher for natural gas projects.

The 2003 benefit-cost ratios are inaccurate because they are based on 2002 prices rather than on more current price information.[2] Specifically, they are based on the average price of natural gas from January through March 2002, after which prices rapidly climbed. For example, the average commodity cost for natural gas rose from about $2.50 per Mcf during early 2002 to over $5.00 in 2003 and 2004.[3] According to the most recent forecast used by the Department of Commerce, commodity costs will range from $4.77 to $6.39 per Mcf between 2005 and 2019. When the benefit-cost ratios for the 2003 program were reported in 2004, they were still based on the 2002 prices even though they were known to be out of date. Had the results been based on more recent price forecasts, the societal benefit-cost ratios would have increased by an average of about 48 percent.[4]

Using appropriate discount rates is also important when calculating the benefits and costs of CIP. As we discussed earlier in this chapter, the benefits of

2 The out-of-date price information includes commodity prices, demand prices, and the escalation factors for these prices. In our analysis, we updated all three of these price inputs.

3 Department of Commerce, unpublished spreadsheet, received by the Office of the Legislative Auditor on December 10, 2004.

4 As we discuss later in this chapter, the Department of Commerce has proposed several corrections to the model used by gas utilities to estimate benefits and costs of CIP projects. To estimate the impact of using up-to-date information and correcting for distortion problems, we used a benefit-cost model that incorporated most of the department's proposed corrections rather than the model currently used by the utilities.

conservation generally occur over a 10 to 20 year period as the energy-efficient products conserve energy over their operating lives. The value of these future benefits must be discounted to reflect that a dollar received in the future is less valuable than a dollar received today.

However, we found that:

- **The use of out-of-date discount rates also resulted in an understatement of the 2003 benefit-cost ratios.**

To determine the discounted value of future societal benefits under the 2003 conservation program, the Department of Commerce required gas utilities to reduce future benefits by 5.88 percent per year. This discount rate is based on the interest rate of 20-year United States Treasury securities and was designed to be slightly higher than expected inflation. When the department updated its assumptions in 2004, it set the discount rate at 4.72 percent because interest rates had declined since the department last revised the discount rate in 2002. However, even though the final benefit-cost ratios for the 2003 conservation projects were prepared in 2004, the ratios were based on the discount rate set in 2002. If the department had used the updated discount rate for gas utilities, the societal benefit-cost ratios would have increased by about 7 percent.[5]

The Department of Commerce's CIP procedures cause the utilities to use out-of-date assumptions.

The department's CIP procedures cause the use of out-of-date assumptions. In preparing their biennial CIP plans, the utilities develop expected benefit-cost ratios for the upcoming two years using economic assumptions (e.g. gas prices and interest rates) and engineering assumptions (e.g. energy-efficiency levels and product operating lives). However, the department requires the utilities to continue using these assumptions when reporting their actual results for the two years covered by the plan. For example, the gas utilities developed their 2003-04 CIP plans in early 2002. Consequently, the utilities used these 2002 assumptions in their 2003 status report and will continue to use them to prepare their 2004 status reports.

To determine if the utilities are meeting program expectations, the Department of Commerce needs the utilities to use assumptions that do not change during the two years covered by each CIP plan. As we discussed in Chapter 1, when reviewing and approving each CIP plan, the department sets spending, participation, energy savings, and capacity savings goals for the utilities. When the utilities report their actual results in their status reports, the department checks to see if the utilities are meeting their goals. This process is particularly important for the energy savings goals because it determines the incentive/bonus payment each utility receives. The more the utilities exceed their energy savings goals, the larger the bonus payments. If utilities are allowed to change their engineering assumptions that determine energy savings, the utilities could manipulate the assumptions to get bigger bonus payments. For example, they could use assumptions that lead to low energy-savings estimates when the goals are set and optimistic assumptions when the results are reported.

The Department of Commerce also requires the utilities to use economic assumptions that do not charge during the life of a CIP plan because these

5 *Ibid.*

assumptions are also part of the department's formula for determining the size of the bonus payment. Depending on how much a utility exceeds its energy savings goal, it receives a bonus payment that is a percentage of the net benefits that its conservation program generates. As we have discussed, economic assumptions (such as natural gas prices and discounts rates) help determine the benefits and costs of conservation programs.

Inconsistencies

We found several inconsistencies among utilities in the methods they use to estimate the benefits and costs of conservation projects. For example, we found that:

- **In 2003, electric utilities did not use the same discount rate to calculate the value of benefits received in future years under the societal test.**

Since this test represents the value of energy conservation to society, the discount rate should be the same for all conservation programs regardless of which utility runs the program. In the 2003 benefit-cost estimates, Xcel Energy and Otter Tail Power used discount rates of 7.87 and 8.0 respectively, considerably higher than the rates of 4.0 and 5.0 percent used by Interstate Power and Minnesota Power. These rates also differ from the rate of 5.88 percent used by gas utilities. To illustrate how these differences affect benefit-cost ratios, we estimated what Xcel Energy's benefit-cost ratio would have been had it used a rate similar to other utilities. If Xcel Energy used a societal discount rate that equaled 4.5 percent (the average of the rates used by Minnesota Power and Interstate Power), its societal benefit-cost ratio for its electric CIP program would have increased by about 29 percent.

Synapse Energy Economics (one of our consultants) found that:

- **Electric utilities do not use the same methods and assumptions as each other to estimate the energy, power plant, transmission line, and distribution system costs that were avoided through conservation, which led to widely varying estimates.[6]**

Some utilities used questionable methods to estimate how much CIP reduced costs associated with constructing new transmission and distribution systems for electricity.

There are large differences in the utilities' methods and assumptions for estimating transmission and distribution avoided costs. We found that utility estimates of transmission and distribution avoided costs per kilowatt of capacity conserved varied by a ratio of more than four to one in 2003. While some utilities pointed out that their unique circumstances lead to differences with other utilities, our consultant found that some of the difference is due to questionable methods used by some utilities. For example, our consultant criticized methods that used historical or expected transmission costs during a short time period to estimate avoided transmission costs over a 10 to 20 year period. The problem is that the costs during a short time period of 1 to 5 years may not be representative of costs over longer time periods because utility investment in transmission line facilities can vary greatly from year to year. If an unusually large transmission project falls

6 Synapse Energy Economics, *Review of Avoided Costs Used in Minnesota Electric Utility Conservation Improvement Programs: Including All Four Investor-Owned Utilities* (Cambridge, MA: November 2004).

within the base time period, the method may cause the utility to substantially overstate the transmission avoided costs. On the other hand, if an unusually small number of projects are expected within the base period, the utility may underestimate the avoided costs. Furthermore, according to our consultant, some utilities do not accurately identify the type of transmission and distribution costs that are avoided by energy conservation.

Our consultant also found problems with energy and power plant avoided costs. He thought that utilities generally made reasonable estimates of avoided energy costs in the near future but likely understated long-term avoided costs. Specifically, some utilities did not account for changes in the energy markets that are likely to occur in future years. For example, the utilities' long-term estimates did not always account for the fact that energy costs tend to increase at rates higher than inflation. When he examined avoided power plant costs, he found some problems that overstated costs but other problems that understated costs. As a result, he could not determine whether the estimates were too high or too low. Overall, the consultant did not find any evidence of major systematic flaws in the estimates.

Because utilities consider information about their energy, power plant, transmission, and distribution costs to be trade secret, we cannot discuss the consultant's findings in detail in this report. However, we have given the consultant's full report to the Department of Commerce so that the department can assess the consultant's specific concerns.

Finally, we found that:

- **The electric utilities used different methods to estimate the value of health and environmental damages that energy conservation avoids, which has led to widely varying estimates.**

To assess the reasonableness of these estimates, we determined the extent to which the methods used by Minnesota's utilities are consistent with the approach recommended by the Minnesota Public Utilities Commission, which regulates utilities.

The Public Utilities Commission, which regulates utilities, has established estimates of the environmental damage caused by energy consumption.

In 1997, the Public Utilities Commission established a range of environmental costs for different pollutants and required the utilities to use these values when planning the state's energy future. The Commission set high and low damage values for five different pollutants for four different geographic areas.[7] Table 2.7 presents these ranges. To determine the environmental benefit of conservation, the damage estimates must be converted from "dollars per ton emitted" into "dollars per megawatt-hour of electricity generated" or "dollars per Mcf burned." The conversion for electricity varies depending on the mix of plants used by the utility because the amount of pollution emitted per megawatt hour of electricity generated varies from plant to plant.

We found that the utilities' estimates of avoided environmental damage per unit of energy conserved were the same for each of the gas utilities but varied widely among the electric utilities. The Department of Commerce requires Minnesota

7 The Commission originally set damage values for six pollutants, but now uses only five.

Table 2.7: Public Utilities Commission's Estimated Environmental Damage per Ton of Pollutant Emitted, 2003

	Urban Areas		Metro Fringe		Rural Areas		Portions of Other States Within 200 Miles of Minnesota	
Pollutant	Low Estimate	High Estimate	Low Estimate	High Estimate	Low Estimate	High Estimate	Low Estimate	High Estimate
Particulate matter	5,119	7,369	2,280	3,311	645	981	645	981
Carbon monoxide	1.22	2.60	0.87	1.54	0.24	0.47	0.24	0.47
Nitrogen oxides	426	1,122	161	305	21	117	21	117
Carbon dioxide	0.34	3.56	0.34	3.56	0.34	3.56	0.0	0.0
Lead	3,592	4,446	1,895	2,289	461	514	461	514

NOTE: The Public Utilities Commission annually updates these estimates based on the Gross Domestic Product Implicit Price Deflator.

SOURCE: Minnesota Public Utilities Commission, "Environmental Externality Values Updated through 2003," http://www.puc.state.mn.us/doc/environext.pdf, accessed July 26, 2004.

gas utilities to use the high end of the Commission's recommended range when estimating the environmental damage that conservation avoids. In the 2003 status reports, all gas utilities used the environmental damage estimate of $0.29 per Mcf. However, the department expects, but does not require, electric utilities to use the Commission's values when calculating the benefits of their conservation projects. Consequently, electric utilities' estimates of avoided environmental damage ranged from $0 to $5.50 per megawatt-hour of energy conserved. While differences in the types and locations of the utilities' power plants explain some of the variation, differences in methods explain a lot of the variation.[8]

While all the natural gas utilities used the Public Utilities Commission's environmental damage estimates, only two electric utilities did.

Two of the four investor-owned electric utilities based their estimates on the values established by the Commission. Xcel Energy based its estimate of approximately $2.00 per megawatt-hour on the high end of the Commission's range for the metro fringe area.[9] But Otter Tail Power's estimate of roughly $0.25 per megawatt-hour was lower primarily because it was based on the low end of the Commission's range for rural areas and other states. Interstate Power's environmental estimate was higher (about $5.50 per megawatt-hour) than the other utilities' estimates because it used the same method that it used for its conservation program in Iowa. This method assumes that environmental damages avoided by a conservation program equals about 10 percent of the energy, power plant, transmission, and distribution costs avoided by the conservation program. Minnesota Power did not report environmental damages avoided by its 2003 program because it assumed that they were already reflected in the cost of electricity. For its 2004-05 biennial plan, Minnesota Power adopted the same method used by Interstate Power.

To determine the impact that this variation in environmental damage estimates had on the utilities' benefit-cost ratios, we recalculated the ratios based on different

8 We rounded the electric utilities' estimates of avoided environmental damage to the nearest $0.25 to reflect their uncertainty. The utilities did not report these figures, but we backed them out based on the avoided cost data that they did provide.

9 Xcel revised its environmental damage estimate to $3.89 per megawatt-hour for its 2004-05 CIP plan. Xcel revised its estimate after reassessing the mix of power plants used to derive the estimate.

estimates. We found that using Interstate Power's approach would increase the societal benefit-cost ratio by roughly 10 percent compared with the approach used by Minnesota Power.

When we examined the scientific literature on environmental damage caused by energy production, we found that damage estimates vary greatly from study to study. For example, a national peer-reviewed study that summarized estimates from other studies found that estimated damage per ton of emission varied by a ratio of 43 to 1 for nitrogen oxide and 14 to 1 for carbon dioxide.[10] The differences are due to a variety of factors, including different assumptions about how pollutants affect human health and the environment, the geography and population density of the area studied, the type of damages included, and the extent to which the studies counted future damages caused by pollutants emitted today.

The Public Utilities Commission's estimates of environmental damage fall in the lower half of the range found in the scientific literature.

The range of values recommended by the Minnesota Public Utilities Commission typically falls within the lower half of the range in estimates we found from examining the scientific literature. In fact, the high end of the Commission's range for the metro fringe is less than half of the median estimated value from the national study for carbon dioxide, nitrogen oxide, and carbon monoxide. While the Commission's environmental damage estimates for urban areas are closer to the median estimates in the national study, the two electric utilities that used the Commission's estimates (Xcel and Otter Tail Power) did not base their avoided cost calculations on the Commission's estimates for power plants in urban areas. Table 2.8 shows the damage estimates from the national study. While some environmentalists argue that the Commission's environmental damage estimates are too low, the Commission went through a lengthy hearing process and weighted a lot of evidence to derive their estimates.

Table 2.8: Range in Estimated Environmental Damage per Ton of Pollutant Emitted, Based on a National Study

	Low Estimate	Median Estimate	High Estimate	Number of Studies
Particulate matter	1,166	3,435	19,875	12
Carbon monoxide	1	638	1,288	2
Nitrogen oxides	270	1,300	11,655	9
Carbon dioxide	2	17	28	4

NOTE: The national study estimated the environmental damage values in 1992 dollars. We updated these estimates to 2003 dollars based on the Gross Domestic Product Implicit Price Deflator.

SOURCE: H. Scott Mathews and Lester B. Lave, "Applications of Environmental Valuation for Determining Externality Costs," *Environmental Science and Technology*, 34, no. 8 (2000): 1390-95.

10 H. Scott Mathews and Lester B. Lave, "Applications of Environmental Valuation for Determining Externality Costs," *Environmental Science and Technology*, 34, no. 8 (2000): 1390-95. We carried out a literature review that revealed a handful of studies that summarize environmental damage estimates. We chose this one because it (1) was published recently in a peer-reviewed journal, (2) presents values in a dollars per ton format that is consistent with the Public Utilities Commission's format, and (3) is based mostly on studies performed in the United States.

Structural Problems

All the investor-owned natural gas utilities in Minnesota use a benefit-cost model that they collaboratively developed with the Department of Commence. However, the Interstate Power and Light Company recently found structural problems in this model. For example, it found that the logic and design of this model was inconsistent with a widely recognized national model. Consequently, the Department of Commerce has proposed changes to the Minnesota model that will correct these problems. We found that:

- **Minnesota's benefit-cost model for natural gas projects generally understated the utilities' 2003 reported benefit cost-ratios because of structural problems in the model.**

Minnesota's model for assessing the cost effectiveness of natural gas projects is not consistent with a nationally recognized model.

If the proposed model had been applied to the 2003 conservation programs, we estimate that the societal benefit-cost ratios would have increased by about 10 percent for the two largest gas utilities (CenterPoint Energy Minnegasco and Xcel) and by 26 to 49 percent for the smaller gas utilities. In addition, the ratio for the participant test would have increased by an average of about 5 percent.

Unlike the other tests, making the ratepayer test consistent with the national model would significantly reduce the benefit-cost ratios. The problem with the current model is that it incorrectly omits a large portion of the utilities' costs from the ratepayer test.[11] Under the proposed model, we estimate that the overall ratepayer benefit-cost ratios would range from 0.6 to 0.7 among the gas utilities, instead of 1.3 to 2.8.

Another problem with the ratepayer test is that it does not recognize the costs borne by the ratepayers for the incentive/bonus payments that the utilities receive for achieving or surpassing their energy conservation goals. As a result of the performance of their 2003 projects, utilities received $11 million in incentive payments. If these payments, which are financed by ratepayers, were included in the ratepayer test, the benefit-cost ratios would have declined by an average of 3 percent for electric utilities and 2 percent for gas utilities.

Distortion Problems

Finally, we found that:

- **While some problems in the utilities' benefit-cost methods and assumptions had modest effects on overall benefit-cost ratios, they had a larger effect on the relative performance of individual projects.**

For example, in 2003, Xcel electric treated the operation and maintenance expenses of its customers who participated in CIP differently than other utilities

11 The national model and Minnesota's current model have the same definition of ratepayer benefits but have different definitions of the ratepayer costs. CIP's costs under the national model include program costs and the utilities' lost revenue from reduced sales. In contrast, CIP's costs under Minnesota's current model include program costs and the utilities' lost profits (rather than lost revenues).

did. In some cases, energy efficient products not only reduce energy consumption but also reduce customers' operation and maintenance expenses. Xcel treated this reduction in expenses as an offset to the customers' costs, while the other utilities treated it as a benefit to the customer. At first glance, this difference may seem purely semantic, but it had an impact on the benefit-cost ratios by putting these avoided costs in the denominator of the ratio rather than the numerator. Xcel's treatment of these avoided costs increased its societal benefit-cost ratio by about 17 percent over what it would have been under the method used by other utilities. But the impact of this method varied greatly from project to project. For example, Xcel's roofing program had a benefit-cost ratio of 3.9, but it would have been 1.7 if it had treated the avoided operation and maintenance expenses the same way as other utilities. According to Xcel, it has recently recalculated the benefit-cost ratios for its 2005-06 CIP plan by categorizing these avoided operation and maintenance expenses the same way as the other utilities.

The Department of Commerce requires natural gas utilities to unrealistically assume that all conservation projects will last no longer than 15 years.

As another example, the Department of Commerce's benefit-cost model unrealistically assumes that gas conservation projects conserve energy for 15 years. The department requires gas utilities to assume that each conservation project would save energy for no longer than 15 years. In practice, most utilities used 15 years as the project life for all projects in their benefit-cost calculations. In contrast to the other utilities, CenterPoint Energy Minnegasco assumed that many commercial and industrial projects would last less than 15 years. However, a utility and our consultant pointed out that gas conservation projects have different project lifetimes and that the current benefit-cost calculations do not reflect those differences. For example, weatherization projects involving attic and wall insulation should have expected lifetimes exceeding 15 years. If the average life of a project were 25 years, its actual benefit-cost ratio would be about 50 percent higher than the ratio reported under the department's 15-year cap. Similarly, the 15-year assumption causes the current benefit-cost model to overstate benefits for projects that conserve energy for less than 15 years.

Other Issues

We asked ACEEE (the other consulting firm that we hired) to review the investor-owned utilities' estimates of (1) "free-rider / free-driver" effects, (2) energy savings, and (3) capacity savings. ACEEE found that:

- **The utilities' free-rider / free-driver, energy savings, and capacity savings estimates were generally reasonable.**

In this chapter, we just summarize the consultant's findings, but we have given the Department of Commerce the consultant's full reports so that the department can address the specific concerns identified by ACEEE.[12]

12 Memorandum from Marty Kushler (ACEEE) to John Patterson (OLA), *Summary Memorandum, Task a (Free-Rider / Free-Driver Assessment)*, October 29, 2004; Memorandum from Harvey Sachs (ACEEE) to John Patterson (OLA), *Summary Memorandum Task c (Energy Savings Assumptions, investor-owned gas, electric, and combination utilities)*, November 11, 2004; and Memorandum from Harvey Sachs (ACEEE) to John Patterson (OLA), *Summary Memorandum Task d (Demand Savings Estimate, investor-owned electric utilities)*, November 11, 2004.

Free Riders and Free Drivers

"Free-rider and free-driver" effects refer to market factors that some utilities include in their benefit-cost calculations. "Free riders" are individuals who participate in a conservation program by taking a rebate but would have purchased the energy-efficient product (such as a furnace) on their own without the rebate. Thus, the energy savings from these individuals would have occurred without the conservation program and should not be attributed to the program. Some utilities reduce their energy savings estimates to account for this phenomenon.

CIP has indirect market effects that are hard to quantify.

Soon after the concept of "free-ridership" was recognized in the conservation field, researchers realized that there was a contrasting phenomenon called "free-drivership." This phenomenon represents individuals who are influenced by the conservation program to buy an energy efficient product but do not bother to get a rebate. For example, an individual may see a CIP financed promotion for an energy-efficient product and buy the product, but not apply for the rebate. The conservation field has also started to recognize other indirect benefits of conservation programs. For example, as conservation programs and demand for energy-efficient products grow, suppliers and retailers stock more of these products and devote more shelf space to them. With higher awareness and visibility, energy customers are more likely to buy these products even without the rebate. In the conservation field, this phenomenon is called "market transformation." To account for "free-drivership" and "market transformation," some utilities increase the energy savings attributed to their conservation programs beyond the energy savings that come from the products sold with a rebate.

Estimating the size of free-ridership and free-drivership/market-transformation effects is costly and very difficult. Consequently, Minnesota utilities generally assume that the competing effects cancel each other out.[13]

According to ACEEE, it is reasonable for Minnesota utilities to assume that free-ridership and free-drivership/market-transformation cancel each other out. Widely respected organizations have stated that this assumption is reasonable. For example, the International Energy Agency stated,

> These indirect effects work in opposite directions and both are difficult to quantify. Until better information is available, it may be practical to assume…that these two effects cancel each other out.[14]

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13 By design, the Department of Commerce's model for calculating the benefit-cost ratios of natural gas conservation projects assume that the free-rider and free-driver effects cancel each other out. With respect to electric conservation, Minnesota Power, Otter Tail Power, and Xcel Energy reduce the energy savings estimates for a few of their energy-efficient products because of free-ridership. Interstate Power and Light assumes that free-ridership and free-drivership cancel each other out for all the energy-efficient products that they sponsor. In 2003, Minnesota Power tried to claim free-driver/market transformation estimates that were greater than their free-rider estimates for its Energy Star program, but the Department of Commerce did not accept these estimates.

14 International Energy Agency, *Initial View on Methodologies for Emissions Baselines* (June 2000). 7.

Furthermore, ACEEE reviewed a range of studies that have tried to estimate the free-rider and free-driver/market-transformation effects. While the studies that just examined free-ridership showed some significant reductions in energy savings, studies that included the combination of free-ridership, free-drivership, and broader market transformation effects generally showed the factors canceling each other out.

Energy Savings

We also asked ACEEE to assess the reasonableness of the energy savings estimates that all eight investor-owned utilities used to report their 2003 program results. For each utility, ACEEE chose a small sample of energy-efficient products and assessed the underlying assumptions that were used to estimate energy savings. ACEEE examined such things as (1) the number of years that each utility assumed its energy-efficient products would operate and provide conservation savings and (2) the efficiency level of the product that each utility assumed its customers would purchase if CIP did not exist. The efficiency level of this baseline or standard product largely dictates the energy savings that CIP creates. If customers typically choose a higher-efficiency product on their own, CIP will provide small savings. Alternatively, if customers would otherwise choose a relatively inefficient product, CIP will provide large savings.

The utilities' energy savings estimates were generally reasonable.

While ACEEE found some questionable assumptions, it found the utilities' assumptions to be generally reasonable. The consultant's review identified some issues across several of the utilities. For example, most gas utilities assume that customers would purchase a 78 percent efficient furnace without CIP, which is the minimum efficiency allowed in the market by Minnesota's energy code and federal appliance standards. However, according to the Gas Appliance Manufacturers Association, 78 and 79 percent efficient furnaces account for only 1 percent of manufactures' shipments. In contrast, the association found that 80 percent efficient furnaces account for 70 percent of the shipments.[15] Consequently, an 80 percent efficient furnace is a better baseline efficiency level to determine energy savings. The utilities' baseline efficiency level of 78 percent overstated the energy savings by about 2.6 percent.[16] However, according to ACEEE, another aspect of the utilities' furnace estimates was conservative. While Minnesota utilities generally assumed a 15-year operating life for furnaces, the U.S. Department of Energy uses 20 years as an average lifetime, with 10 years as a low estimate and 30 years as a high estimate.[17]

In contrast to furnaces, Minnesota gas utilities assumed a longer than expected operating life for hot water heaters than the U.S Department of Energy assumes. The natural gas utilities usually assumed an operating life of 15 years in their 2003 energy-savings estimates, while the U.S. Department of Energy assumes 9 years. Yet, ACEEE still felt that Minnesota's 15-year assumption could be

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15 Letter from Mark Kendall, (Director, Technical Services, Gas Appliance Manufacturers Association) to Cyrun Nasseri (U.S. Department of Energy), April 10, 2002.

16 Depending on the utility, the furnaces receiving rebates have a 90, 92, and/or 94 percent efficiency level.

17 U.S. Department of Energy, *Technical Document: Energy Efficiency Program for Consumer Products, Energy Conservation Standards for Residential Furnaces and Boilers,* Table 8.3.2; http://www/eere/energy.gov/buildings.appliance_standards/residential/furnaces_boilers_1113_r.htm.

considered reasonable. First, ACEEE argues that the U.S. Department of Energy has historically assumed that hot water heaters last 13 years and did not adequately explain why it recently switched to a 9-year assumption. Second, the operating life of hot water heaters varies with water chemistry. With the right water chemistry in Minnesota, a 15-year assumption may be reasonable.

Capacity Savings

In addition, the utilities' capacity savings estimates were generally reasonable.

The last task that we asked ACEEE to carry out was to assess the estimates of capacity savings that the four investor-owned electric utilities' used to report their 2003 CIP results. ACEEE found that the utilities estimates were generally sophisticated and done appropriately. All four electric utilities rely on a model called DSManager to derive the capacity savings created by their conservation programs. According to ACEEE, DSManager is a "powerful" and "sophisticated" tool. The program allows utilities to enter data about (1) the operation of their power systems and (2) the consumption patterns of their customers, which are broken out by the various electricity-consuming products that the customers operate. Based on these data, the model determines the extent to which conservation reduces the need for new electric system capacity.

ACEEE also examined a sample of the capacity savings estimates developed by each electric utility and generally found them to be appropriate. Depending on the utility and conservation project, ACEEE's method for assessing the appropriateness of the assumptions varied. For example, for commercial lighting projects, ACEEE calculated the ratio of capacity-savings to energy-savings, which should be relatively constant between utilities and across the country. While this measure is not a formal engineering review, it provides an indirect indication of the reasonableness of the assumption. In the cases that ACEEE reviewed, the Minnesota utilities' ratios were relatively consistent with those found in California.[18]

However, ACEEE has one primary criticism of the Department of Commerce's review of the utilities' capacity savings. Because the department does not own or have access to the DSManager model or have a staff person trained in its use, it does not have sufficient resources and expertise to fully review the utilities' CIP submissions. To improve its review process, the department needs access to this model. However, the department may have difficulty purchasing a license to use it because the company that owns the model is no longer actively supporting it. Consequently, ACEEE recommends that the department gain access to DSManager through one of the Minnesota utilities and have a department staff member trained in its use. Alternatively, the department could require the utilities to select a new model/software package, which would be equally accessible to the utilities and department. We discuss this recommendation further in Chapter 3.

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18 Pacific Gas & Electric, *Evaluation of Pacific Gas & Electric Company's 1997 Commercial Energy Efficiency Incentives Program: Lighting Technologies* (San Francisco, 1999), Exhibit 4-12.

CORRECTIVE ACTION

If the methodological problems outlined in the previous sections are not corrected, the utilities and Department of Commerce may draw incorrect conclusions about the performance of conservation projects.

RECOMMENDATION

The utilities and Department of Commerce should correct the methodological problems in the utilities' benefit-cost estimates.

Both the utilities and the department need to take action. The utilities should correct the problems under their control, but the department should verify and ensure that the utilities have taken sufficient corrective action. For example, the department should verify that the utilities are basing their estimates of avoided environmental damages on the methodology established by the Public Utilities Commission. The department should also ensure that the electric utilities' estimates of avoided energy and capacity costs are comparable with each other. Differences in the estimates should reflect differences in costs between the utilities rather than differences in methodology.

Incorrect conclusions about CIP's performance may be drawn if methodological problems in assessing cost-effectiveness are not corrected.

The department also needs to change some of the methods and assumptions that it requires the utilities to use. As discussed earlier, the department is already examining potential changes to the benefit-cost model for natural gas projects. These changes will hopefully address the structural problems identified by Interstate Power and Light. The department should also allow the utilities to use up-to-date economic assumptions (such as natural gas prices and discount rates) when the updated information will have a significant impact on the benefit-cost calculations. While it would be unproductive for the department to reexamine and reassess all the utilities' benefit-cost calculations every time an economic indicator changes, some changes are large enough to warrant a reexamination. However, the department has concerns about the impact that updated economic assumptions will have on the operation of the department's incentive/bonus payment system. As we discussed earlier, utilities that meet or exceed their energy savings goals receive bonus payments, and the size of these payments are partially determined by the net benefits that the utilities' conservation programs generate. While we did not have the time to research all the ramifications that updated information will have on the process for determining the bonus payments, we strongly encourage the department to develop a mechanism for ensuring that benefit-cost ratios that are published in the utilities' status reports are accurate.

COST-EFFECTIVENESS IN THE PAST AND FUTURE

Some critics of CIP suggest that the program is becoming less effective over time and may become ineffective in the near future. There are a couple reasons why CIP could potentially experience diminishing returns over time. In theory, as

As CIP completes the most cost-effective projects, the program may be left with less effective projects over time.

utilities focus their conservation efforts on those products and processes with the highest benefit-cost ratios, the state and utilities will be left with conservation strategies that are less and less effective over time. Consequently, the state and utilities could see a decline in the cost-effectiveness of their conservation efforts.

Furthermore, in some product areas, customers have no choice but to buy high-efficiency products. This occurs if the state sets building and energy code standards high enough to only allow high-efficiency products or if the federal government sets efficiency standards for appliances sufficiently high. For example, in January 2006, the federal government will raise the efficiency standards for air-conditioners.[19] Some utilities claim that the change will make their conservation projects for air-conditioners ineffective.

When we examined the issue of diminishing returns, we found that:

- **In recent years, CIP does not appear to have experienced a significant decline in its performance.**

Despite the prospect of diminishing returns, the societal benefit-cost ratio of CIP has not declined significantly in recent years, as shown in Figures 2.1 and 2.2. Figure 2.1 applies to electric conservation activities, and Figure 2.2 applies to natural gas activities. While there was a substantial drop in the benefit-cost ratio for electric utilities between 1997 and 1998, the ratio has been quite stable for the last six years.[20] For natural gas conservation, the five investor-owned utilities (which excludes Xcel) have had a stable societal benefit-cost ratio. We excluded Xcel from this analysis because we did not obtain good consistent data that covered several years.[21] We also examined the energy savings per dollar of CIP spending that the utilities achieved between 1992 and 2003. CIP's performance has not declined much, if at all, in the last decade.

To address the issue of cost-effective conservation in the future, we contracted with ACEEE to assess the amount of future energy savings that could be achieved in Minnesota. To do this, ACEEE reviewed Minnesota studies that have addressed this issue and compared them with studies from other states and regions. The Minnesota studies were prepared by Interstate Power and Light (which uses Iowa information as a proxy for its Minnesota service territory), Otter Tail Power, and Xcel Energy. While these studies represent only three of Minnesota's eight investor-owned utilities, they provide a rough indication of the potential for future energy savings in the state. ACEEE also carried out a comprehensive national literature search and obtained information about future

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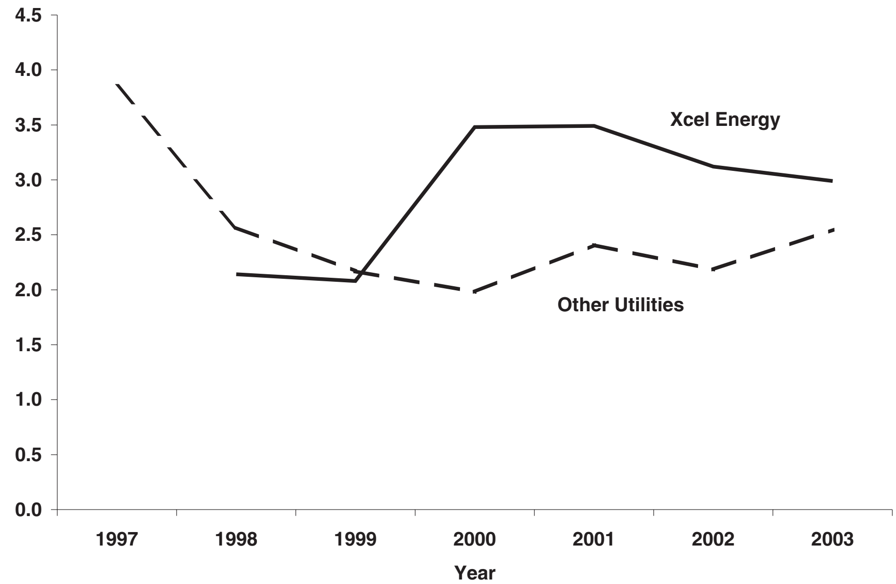
19 10 C.F.R. Part 430 (January 22, 2001).

20 For electric conservation programs, we report Xcel's benefit-cost ratios separately from the other utilities because Xcel reports its information in a different format than the other utilities. Consequently, we could not easily aggregate it with benefit-cost information from the three other investor-owned electric utilities. Specifically, Xcel reports its benefits and costs in terms of dollars per customer kilowatt, rather than in simple dollar terms. With limited resources, we decided not to gather historical information on Xcel's customer kilowatts in order to convert Xcel's benefits and costs to simple dollar terms.

21 While Xcel provides about one-quarter of the natural gas that is consumed in Minnesota, Xcel would have had to experience a very sizable change in its conservation performance to significantly affect the trend line shown in Figure 2.2.

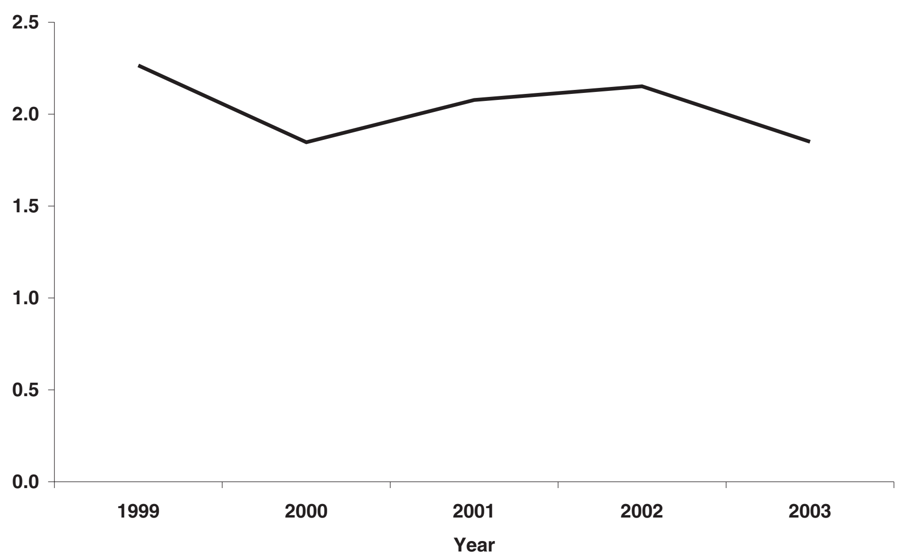
Figure 2.1: Societal Benefit-Cost Ratios, Investor-Owned Electric Utilities



SOURCE: Office of Legislative Auditor analysis of utility CIP data.

In recent years, CIP's benefit cost ratios have been relatively stable.

Figure 2.2: Societal Benefit-Cost Ratios, Investor-Owned Natural Gas Utilities



NOTE: Excludes Xcel Energy due to inconsistencies in reported data.

SOURCE: Office of the Legislative Auditor analysis of utility CIP data.

energy savings from 17 studies that had been conducted in the U.S. in the past four years.[22]

According to ACEEE's review of these studies,

- **CIP has the potential to provide cost-effective conservation in the future.**

Between 10 and 30 percent of Minnesota's future energy needs could be met through cost-effective conservation.

The Minnesota studies indicate that between 10 and 20 percent of future electric load in Minnesota could be met through cost-effective conservation.[23] The figure varied by utility and distance into the future being projected, which was five to twenty years. ACEEE's review also found that other states and regions could save between 10 and 30 percent of their future load through efficiency measures, which is relatively consistent with the Minnesota estimates. According to ACEEE, between 15 and 30 percent of the future load for natural gas utilities in Minnesota could be met through cost-effective conservation. The savings potential for other states and regions varied between 10 and 35 percent.

These findings need to be put into some context. First, the estimates apply to cost-effective conservation measures, some of which may not be achievable because of practical limitations. For example, while installing compact fluorescent lights are a cost-effective conservation strategy, some people do not buy them because they do not like the quality of the light provided. Several of the studies from other regions of the country that ACEEE reviewed estimated both cost-effective and achievable savings. In these studies, the estimates of achievable savings were 23 to 52 percent lower than the estimates of cost-effective savings. In general, the Minnesota studies did not report achievable energy-savings estimates. Second, we asked ACEEE to examine a full range of perspectives concerning opinions about the potential for future energy savings, including entities that believe conservation is no longer cost-effective. According to ACEEE, they could not find any published studies that showed no potential for cost-effective or achievable energy savings in the future.

During our interviews with the investor-owned utilities, they expressed opinions that are consistent with our assessment of past conservation performance and ACEEE's assessment of future energy savings. The utilities told us that while they have had some difficulty finding cost-effective conservation projects (particularly in certain market segments), they believe that Minnesota has not reached the point where diminishing returns has made CIP ineffective. Several factors have helped utilities continue to provide cost-effective conservation. First, technological changes are leading to the development of higher efficiency products and processes, such as light bulbs. Second, as utilities saturate the

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22 With respect to electricity, the states and regions covered in these studies were California, Connecticut, Iowa, Massachusetts, New York, Oregon, Vermont, Puget Sound, Southwestern United States, and the United States as a whole. With respect to natural gas, the studies covered California, Iowa, Oregon, Utah, Puget Sound, and the United States as a whole.

23 Neither the Xcel Energy study nor Otter Tail Power study actually reported their results in terms of percentage of future load that could be met by energy efficiency. Rather, they just reported the total GWh savings potential for the years in question. To derive a percentage figure for comparison purposes, ACEEE calculated projected future load for each utility by taking actual 2003 sales data and escalating future sales at a rate of 1.5 percent per year. The reported percentages for Xcel and Otter Tail are proxy values derived by ACEEE using each utilities' actual 2003 electric sales, a 1.5 percent annual escalation rate, and each utilities' projected future energy savings potential (GWh).

market with a high-efficiency product, they can switch to products and markets that still have a lot of potential for cost-effective conservation. For example, Xcel claims that it has achieved 70 to 80 percent market saturation for high-efficiency lighting for its large commercial customers. Consequently, Xcel is shifting its focus to providing customized conservation projects to improve the efficiency of industrial processing.