Alaska Rural Energy Plan

Initiatives
For
Improving
Energy Efficiency
and
Reliability

Volume I
Executive Summary

Prepared for:
Alaska Energy Authority

With Support from
Denali Commission
USDA Rural Development

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In Collaboration with
Northern Economics, Inc.

April 2004

Contents

Abbreviations

ANTHC	Alaska Native Tribal Health Consortium
NREL	National Renewable Energy Laboratory
NIST	National Institute for Standards and Technology
PCE	power cost equalization
PUC	Texas Public Utilities Commission
RPS	Renewables Portfolio Standard
IPP	Independent Power Producer
KEA	Kotzebue Electric Association
NREL	National Renewable Energy Laboratory
DOE	U.S. Department of Energy
AOC	Atlantic Orient Corporation
AVEC	Alaska Village Electric Cooperative
ISER	Institute for Social and Economic Research
TDX	Tanadgusix Corporation
kWh	Kilowatt hour
MAFA	Mark A. Foster and Associates
PURPA	Public Utilities Regulatory Policy Act of 1978
RTED	real-time economic dispatch
APT	Alaska Power and Telephone
ARECA	Alaska Rural Electric Cooperative Association
SCADA	Supervisory Control and Data Acquisition
AMR systems	Automated meter reading systems
CFL	compact fluorescent light
AEA	Alaska Energy Authority
kWh_{sold}	Kilowatt hours sold
MWh	Megawatt Hours
KW	Kilowatt
KVA	Kilovolt-Ampere

Foreword

This report was prepared as part of the Alaska Energy Authority's assessment of opportunities to improve the efficient, reliable delivery of rural Alaska energy services.

This report builds upon the foundations provided in earlier reports on rural Alaska energy infrastructure concerning cost effective technology options (Screening Report, 2001) and efficient operations, maintenance, and management of rural utilities (OMM Report, 2001). This report seeks to supplement that earlier work with analyses of new and recently available data on rural electrical and heating loads; residential and school end-use consumption; diesel generator unit condition, vintage, and performance; housing stock; end-use program effectiveness assessments; energy market redesign and transformation efforts; cost information on diesels; control systems; combined heat and power; wind systems; lighting; and residential electrical and heating appliances.

Significant energy savings in rural Alaska electrical and heating are possible by coordinating community planning, improving market incentives, expanding consumer education efforts, encouraging management best practices, extending metering and telemetry to enable more effective management of electric utilities, and leveraging cost-effective capital equipment investments for utilities and end-users.

Although many efficiency measures have been adopted by utilities and end-users, without an aggressive effort to make efficiency a priority, the prospects for further efficiency gains appears modest due to the confluence of several market impediments including: an existing subsidy system (PCE) that "takes back" the benefits of efficiency improvements, small dispersed energy markets, limited information and availability of alternatives, and the high payback requirements of rural households when trading off first cost and energy savings.

This report identifies promising approaches to address those impediments from a viewpoint that assumes general acceptance of the principles of a market economy. The potential for improvements is spread widely and must be pursued on many fronts. Concerted efforts are required to provide managers and end users with a share of the benefits of their efforts to improve efficiency, leverage investment in improved equipment and infrastructure, and increase attention on energy efficiency.

The authors benefited greatly from the substantial assistance received from many organizations and individuals in the course of this study. Interviewees helped to ensure that a wide variety of perspectives were portrayed, and reviewers of individual sections have contributed greatly to its accuracy and completeness.

MAFA and Northern Economics, Inc. wish to express their appreciation for the generous contributions and support of those many contributors.

Omissions and commissions remain the sole responsibility of the primary author.

1 Introduction

Rural Alaska utilities, schools and residential households account for approximately $170 million in annual energy expenditures: utility payments for fuel & non-fuel costs; school payments for heating fuel & electricity; residential household payments for heating fuel & electricity; and PCE payments to utilities.

Using a combination of utility management best practices, investments in commercially available cost-effective production and end-use technologies, and fine tuning of the Power Cost Equalization (PCE) incentive structure, rural energy efficiency could be increased by approximately 25 percent over the next 15 years, compared to business as usual.

The Rural Energy Plan envisions investing approximately $55 million over *five* years and achieving benefits on the order of $68 million over *fifteen* years, for a benefit cost ratio of 1.23, and net benefits on the order of $13 million [See Appendix: Rural Alaska Energy Plan Summary].

While estimates of the savings potential may vary significantly depending upon future market conditions (e.g., variation in the price of fuel), there appears to be general agreement among those interviewed for this report that the potential for improved energy efficiency for utilities, schools, and households in rural Alaska remains significant.

The new program initiatives include:

- Investments in measurement and monitoring systems to improve operations, maintenance, and management performance
- Annual rural energy conference to share operations, maintenance and management best practices
- Improvements in management efficiency incentives
- Rural community energy awareness meetings
- Capital Investments:
  - Diesel system technology, including new efficient gensets
  - Combined heat and power (cogen) systems
  - Wind-Diesel hybrid systems
  - End-Use lighting and appliances
- Rural School Model Energy Code

1.1 Operations, Maintenance, & Management

Operations, Maintenance, & Management

A) Invest in systems to measure operations, maintenance, and management performance

B) Sponsor annual rural Energy conference to:

1) Facilitate identification and sharing of best practices

2) Provide formal recognition of best O&M practices with annual micro-grant awards program

C) Reduce regulatory uncertainty associated with consolidation, mergers and acquisitions of rural electric utilities

D) Improve customer choice and enhance competitive market dynamics

1.1.1 Measure Performance

The adage "you can't manage what you don't measure" applies to rural Alaska energy. A necessary condition for improved efficiency performance is to understand the efficiency of the current system and then identify what measures are likely to improve efficiency.

In order to improve the efficiency performance of rural Alaska electric utilities—especially those utilities that tend to have modest local resources—a high priority should be placed on investing in new cost-effective metering that allows measurement, recording, and remote monitoring of rural electric utility system efficiencies.

An initial program of $2 million a year over five years is recommended to initiate improved management practices at the 60 to 80 utilities that tend to have modest local resources and periodically require outside assistance to maintain their systems.[1]

Utilities that install and maintain the metering systems to enable remote metering of system efficiencies are then eligible for matching grants for diesel system efficiency improvements.[2] In many cases, once system efficiencies are measured and evaluated, modest changes in operations may be able to achieve significant efficiency improvements. After the low hanging fruit of operational changes are pursued, matching capital grants should be available to target cost-effective system improvements. An initial program of $2 million a year in matching grants (50 percent grant/50 percent local contribution) over five years is recommended for those capital improvements.

The installation of remote metering has the secondary benefit of reducing the uncertainty of potential new management when evaluating the attractiveness of providing service to a utility with modest local resources.

The total program cost of $4 million a year is included in the diesel technology spreadsheet and analysis in the Appendix.

1.1.2 Annual Rural Energy Conference

In order to facilitate identification and sharing of management, operations, and maintenance best practices, and to provide a forum for formal recognition of best O&M practices with a micro-grant awards program, an annual rural energy conference is recommended. Travel funds should be made available to enable broad participation from rural communities. In addition, formal recognition of three best O&M practices may be provided at the conference in the form of a presentation of the "case study" followed by a micro-grant of $5,000 for each winner.

[1] The communities of interest typically include those that have received circuit rider assistance. MAFA recommends that the "measurement system" procurement be either one (100%) or two (50/50) contracts where contract performance includes keeping measurement systems operating over more than one season.

[2] System efficiency metering data should be a prerequisite to receive diesel efficiency matching grants.

1.1.3 Improve Management Efficiency Incentives

In response to the draft Screening Report for the Alaska Rural Energy Plan (2001), some expressed concern that the existing Power Cost Equalization (PCE) program did not provide utility managers with efficiency incentives. A few suggested that, on its face, the PCE formula appeared to reward inefficient utility managers by reimbursing 95% of a utility's costs between the "urban price floor" and the "rural price cap" of 52.5 cents per kWh. Others expressed concerns with utility regulatory policies that reduced rather than enhanced the prospects for regional consolidation of rural utilities.

In response to these and other concerns, the Alaska Energy Authority is participating in ongoing policy reviews of the PCE program.

To improve management efficiency incentives, MAFA recommends an independent review of the Regulatory Commission of Alaska (RCA) process for reviewing regional consolidation, mergers and acquisitions with the goal of reducing the regulatory uncertainty, streamlining timelines and reducing the cost of the process.[3]

1.1.4 Improve Customer Choice & Enhance Competitive Market Dynamics

In order to improve customer choice of energy services and enhance the competitive market dynamics in rural Alaska communities, the Alaska Energy Authority (AEA) should sponsor local community energy awareness meetings.

AEA could act as a neutral third party facilitator of a community meeting by:

- Inviting local residents, businesses, and school administrators to attend; provide 50 gallon drums of fuel oil as door prizes
- Inviting energy service providers (utilities, fuel suppliers, wind and end-use program contractors, etc.) to make presentations of what they have to offer
- Providing independent technical support staff

The goal of the sponsored meeting is to provide:

- Heightened community awareness of energy issues
- A neutral forum for energy service providers to highlight their respective services
- Independent third party technical support to assist community members with questions concerning energy service provider presentations

1.1.5 Operations, Maintenance, & Management Summary

In total, the operations, maintenance, and management program recommendations above (excluding diesel system capital investments which are included below) are estimated to have direct costs of approximately $250,000 per year over five years.

[3] The independent review could begin by examining the APUC rejection of the AVEC-Bethel Merger. Charlie Walls, former general manager of AVEC, has suggested that, in addition to the process being uncertain, long and costly, the potential for the larger merged regional cooperative to be able to take over smaller troubled utilities was not adequately considered.

1.2 Electric Utilities Diesel Generation & Distribution

In historic perspective, rural electricity consumption grew from 293 MWh in 1990 to 391 MWh in 2000, a 33 percent increase in ten years. At the same time, utility fuel consumption rose from 24.8 million gallons a year to 27.7 million gallons a year, a 12 percent increase. Aggregate fuel efficiency rose from 11.8 kWh_{sold} per gallon to 14.13 kWh_{sold} per gallon, a 19.5 percent increase. Thus, over the course of the 1990s, fuel efficiency gains saved rural Alaskan utilities roughly *5.5 million gallons of fuel per year.*[4]

Under nearly ideal conditions, the *aggregate* efficiency of rural Alaska diesel technology may approach 15.2 kWh_{sold} per gallon in the next 10 years.[5] At best, the aggregate fuel efficiency might be able to improve 7.6 percent compared to the actual 19.5 percent improvement in the prior decade. In short, most of the "low hanging efficiency fruit" have already been picked by the utilities. The "last 10 percent" (in this case the last 7 percent toward the top of the tree) of improvement will require a disciplined effort to target the most cost-effective combination of capital, operations and management measures to achieve the theoretically remaining efficiency gains. On paper, the remaining "low hanging diesel efficiency fruit" tend to be found in small remote villages where local management, operations, maintenance, and financial capacity may be a larger challenge than capital investment.

As more fully discussed in the Management Section above, in order to effectively target the remaining diesel system efficiency gains, the first step for many utilities is to upgrade, replace, or install new metering systems. This will enable managers (and public and private funding entities) to quantitatively assess whether the next increment of efficiency is cost-effectively obtained through a change in operations, maintenance, management, new controls, or new diesel generators or some combination.

Through the end of 2003, AEA has issued two solicitations for Energy Cost Reduction Proposals and funded 19 projects for a total project cost of $12.3 million: $5.3 million in grants and $7.0 million in local match. This program appears to be an effective way to accelerate the realization of diesel system efficiency gains, as well as open the door to other beneficial projects, including hydroelectric, line extension and cogeneration heat recovery.

Summary:

Investment:	$1.5 Million a year in metering + **$2.5 Million a year in targeted capital over five years**
Benefits Estimate:	$16-$20 million over 15 years
Benefit/Cost Ratio:	0.92 - 1.15

[4] Over the same time period, new energy efficient lighting, electrical appliances, and space heating units were placed into service, typically reducing energy inputs required to maintain the same or in many cases expanded outputs. Unfortunately, we have been unable to find historic end-use consumption data comparable to that available from utilities so it is difficult to know how large the end-use efficiency gains may have been in the 1990s.

[5] Assume ideal aggregate *average* diesel generation efficiency of 16 kWh generated per gallon and "aggregate distribution and station loss" of 5% of kWh sold. Thus, kWh sold = [kWh generated * (1-distribution loss)], or 16 * [1-.05] = 15.2 kWh sold per gallon.

1.3 Combined Heat & Power Systems (Cogeneration)

Approximately 27 percent of the existing rural Alaska electricity diesel generating plants operate combined heat and power systems where heat from the diesel generator jacket water is used to reduce the need for fuel consumed by heat-only boilers.[6]

System configurations vary widely. Some communities have a district heating system where multiple buildings are served by the heat from the diesel plant. Others use the heat from the diesel plant for the washeteria, water tank, piped water distribution system, or other heating load.

Based on a preliminary assessment of the market, it appears that 70 percent of rural Alaska communities should be able to make cost effective use of combined heat and power systems, whether to heat a school, clinic, water system or other local energy need.[7]

However, it appears that, despite the economic benefits on paper, potential buyers of the heat from the utility (school administrators, water utility managers) may not be buying due to conflicting information about the benefits and concerns about reliability and control. These potential customers may benefit from *standardized contracts* that reduce the level of effort required to execute mutually beneficial arrangements. Standardized contracts also have the potential to improve comparability of contracts and enable buyers to have some confidence that they are getting a "reasonably" good deal compared to others who are similarly situated.

The rural energy plan recommends $50,000 to be invested in developing template agreements for schools, water utilities, clinics, offices, etc. In addition, the plan recommends $100,000 a year over five years be made available as "micro grants" ($10,000 each) to school administrators and water utility managers to help them explore the feasibility of using heat from their local electric utility.

In order to expand the addressable market and improve the potential value of the combined heat and power systems, schools and water utilities may benefit from *standardized system designs* that take advantage of the quality and quantities of heat typically available from utility diesel cogeneration systems. The rural energy plan recommends $100,000 to be invested in developing school heating system design guidelines.

In addition, the plan recommends making available $500,000 a year for five years in matching grants for repairs, upgrades, and expansions of existing combined heat and power systems to enable reliable, cost-effective delivery of heat from diesel plants to local heat customers.

Finally, in light of the potential for small office and residential household scale combined heat and power units, the plan recommends that $200,000 be made available for micro combined heat and power demonstration projects in rural Alaska.

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[6] See Rural Electric Utility Facility Assessment, 2000.

[7] As it turns out, ice making is a common use of combined heat and power systems in Northern Europe. Some rural Alaskan utilities appear to have successfully provided ice making capability in conjunction with their energy systems. Kotzebue has installed an ice making system to take advantage of the "extra" energy available from its wind-diesel hybrid system during the summer when the ice can help extend the fish processing capabilities of an area. So in addition to improving energy efficiency and displacing fuel, creative use of combined heat and power systems may create opportunities for new economic development.

Summary:

Investment: $630,000 a year average over five years

Benefits Estimate: $2.3 - $4.6 million over 15 years

Benefit/Cost Ratio: 0.85 to 1.66

1.4 Wind Power

Following the oil price spikes of the 1970s and early 1980s, there was a resurgence of interest in wind power. Neil Davis, in *Energy Alaska* reported that:

> A compilation of wind energy conversion machines given by Reckard and Newell (1981) indicates that there were approximately 100 machines in operation or planned for operation in 1981.
>
> Approximately two-thirds of the installed systems were independent of other energy systems – that is they are battery charging systems – but the other one-third are tied into existing utilities. The independent battery-charging system range in size from a rated maximum power output of 24W to 10kW, and the wind-energy converters hooked to utility systems range from a maximum rated output of 1.5 to 20 kW.

The level of interest appeared to subside as diesel fuel prices tended to decline in real terms from highs in the early 1970s and the maintenance challenges of wind turbines in remote arctic environments proved more daunting than some had anticipated.

Within the past five years, as the cost of wind power has continued to decline faster than diesel and wind turbine technology has improved, there has been a resurgence of interest in rural Alaska *utility scale* wind turbine systems.

Beginning in 1997, Kotzebue Electric Association (KEA) installed a low penetration wind-diesel system. The wind turbines in Kotzebue were funded as three distinct project phases. In 1997 (first phase), KEA installed the first three grid-connected wind turbines. These turbines have been operating continuously for nearly five years. Through a grant from the National Renewable Energy Laboratory (NREL) and direct appropriations from the U.S. Department of Energy (DOE), seven additional turbines were installed in 1999.

For the 12-month period, January 2000 through December 2000, the Kotzebue wind facility delivered 1,064,000 kWh of electricity to the Kotzebue distribution system, (106,400 kWh/turbine) operating at an 18.3 percent average capacity factor**.** The long term projected output achieved in calendar year 2000 was 104.4 percent.[8] The overall wind turbine system availability was 98.3 percent.[9] The average annual wind speed was reported at 5.9 meters per second (13.2 miles per hour) at a 26.5-meter hub height, which would tend to characterize the site in wind power class 3.[10]

[8] Thus, with 10 turbines, the average turbine output was 106,400 kWh/year in 2000 operating at 104.4 percent of the long-term projected output. Thus, the long run average output per turbine delivered to the grid is estimated at 102,000 kWh/year per the DOE Wind TVP statistics. This compares to a net per turbine output of 118,730 kWh/year used by Global Energy Concepts in their January 2000 Wind Power Economic Evaluation—an apparent downward revision in the long term energy output of roughly 14 percent.

[9] DOE Wind Turbine Verification Program Web Site , “TVP Projects at a Glance.”

[10] It is interesting to note that the NREL Wind Resource Atlas estimated the wind resource in Kotzebue as a wind power class 6.

Other recent utility scale wind turbine projects include St. Paul and Wales:

- The system in St. Paul Island is a high penetration system with no electrical storage, although "excess energy" is stored in a hot water tank. The hybrid system is designed to support an 80,000 square foot industrial facility (called POSS Camp) owned by Tanadgusix Corporation. The wind turbine power system provides both electric and thermal energy to the POSS Camp. The installation of the hybrid system was completed on March 31, 1999 and was formally commissioned on June 12, 1999.
- The Wales diesel power system consists of three diesel generator sets rated at 75 kW, 142 kW, and 148 kW. The system is manually controlled and essentially run as a single-diesel plant. The Wales wind-diesel hybrid power system consists of the diesel generator sets, two 65-kW wind turbines, a 156 kVA rotary power converter, a 31 kWh battery bank, and a 234 kW electric boiler secondary loads system controls. The estimated average annual penetration of the hybrid system is about 100 percent and the peak penetration was estimated at approximately 350 percent.

Based on an economic analysis of currently available individual PCE eligible communities, roughly 31 rural Alaska communities representing 15,000 residents, present **attractive** opportunities for wind resource development, with reconnaissance benefit/cost ratios ranging from 1.0 up to 1.7. These communities represent, in aggregate, a total present value benefit of $38.6 million and a total present value cost of $35.2 million.[11] The potential net economic benefits from these communities are sufficient to justify a wind resource development program on the order of $35 million, including $1.6 million for detailed reconnaissance, preliminary design, and final feasibility, plus $27.5 million for final design and construction contingent upon a finding of net economic benefits at the final feasibility analysis stage.[12]

Another 17 communities representing 16,000 residents represent **potentially attractive** opportunities for wind resource development, with reconnaissance benefit/cost ratios ranging from 0.85 to 1.0. These communities represent, in aggregate, a total benefit of $53 million and a total cost of $58 million under the medium wind penetration scenario. While the benefit/cost ratio estimates for these communities are less than one in the preliminary reconnaissance for medium wind penetration, they are within the margin of uncertainty associated with the market reconnaissance. As such, they appear to warrant additional in-depth record and on-site reconnaissance to reduce the uncertainty of the potential value of wind resource development in these communities.[13]

Based on this initial market reconnaissance study, the Rural Energy Plan recommends a **wind resource development program on the order of $30 million over roughly five years** ($27.5M capital + $1.6 M Wind Recon).

The wind resource development program includes detailed site-specific reconnaissance, preliminary design, and final feasibility, and, contingent upon final feasibility determinations, is expected to reach around 30 rural Alaska communities representing on the order of 15,000 rural residents.

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[11] Total Cost = Capital + O&M + Wind Development Program Costs = $27.5M + $6.1M + $1.6M = $35.2M. All figures are expressed in present value 2002$, based on cash flow estimates over a15 year life using a 5 percent real discount rate.

[12] See Figures 2.2 and 2.3: Wind Resource Assessment Program

[13] Please note that Kotzebue has a benefit/cost ratio of 0.86 in the market reconnaissance study under the medium wind penetration case. An investment in additional reconnaissance in these **potentially attractive** communities is roughly equivalent to buying an option on the potential that the B/C for wind resource development in these communities will exceed one after further reconnaissance.

In order to maximize the economic value of wind resource development, the recommended program focuses on systematically reducing the uncertainty associated with the initial market value estimates. A review of best practices in the industry suggests a program where construction funds are not committed until a final project feasibility assessment is made based upon detailed site-specific reconnaissance and *at least* two to three years of detailed local wind data at the proposed site.[14]

Summary:

Investment:	$6 million a year average over five years
Benefits Estimate:	$30 - $40 million over 15 years
Benefit/Cost Ratio:	0.9 to 1.1

1.5 End-use heating & electricity

The review of end-use heating and electricity markets focused on rural households and schools as the two primary markets where the adoption of cost-effective, energy-efficiency measures appeared to be relatively modest compared to the commercial sector.

1.5.1 Households

Of the approximate 30,000 rural Alaska households identified in the 2000 Census, it appears that nearly 25,000 of those households participated in the PCE program in FY00. The average rural household energy consumption is outlined below.

[14] See National Wind Coordinating Council, Wind Energy Series No. 4, January 1997.

Table ES-1. Typical Alaskan Household Energy Consumption

	Rural Average	Anchorage	Fairbanks	Juneau
Median Household Income (MHI)	$40,380[15]	$55,546	$40,577	$62,034
Annual Electric Consumption	5040 kWh	7782 kWh	9048 kWh	10,428 kWh
Average Price[16] (After PCE)	$0.20/kWh	$0.095/kWh	$0.089/kWh	$0.102/kWh
Annual Amount	$1080	$739	$805	$1064
Electricity as Pct of MHI	2.7%	1.3%	2.0%	1.7%
Space Heating Consumption	700 gallons per year	2100 CCF per year	1500 gallons per year	1000 gallons per year
Average Price	$2.00 per gallon[17]	$0.40 per CCF	$0.75 per gallon	$0.79 per gallon
Annual Amount	$1400	$890[18]	$1125	$790
Heating Consumption as Pct of MHI	3.5%	1.6%	2.8%	1.3%
Electric + Heating Consumption as Pct of MHI	**6.2%**	**2.9%**	**4.8%**	**3.0%**

Sources: PCE Annual Reports, Natural Gas Feasibility Studies, CBJ, MAFA estimates

In aggregate, rural Alaska households consume approximately:

Electricity	126,000,000 kWh/year	$38.7 million/year	
		Less	$16 million/year PCE
		Net	$22 million/year
Heating Fuel	17,500,000 gallons/year	$35 million/year	
		Less	$ 9 million/year LIHEAP
		Net	$26 million/year

Of the total rural Alaska household consumption of approximately 126,000,000 kWh a year, there appears to be a 33 percent *potential savings* due to end-use efficiency (including fuel switching).[19]

[15] The weighted average rural Alaska median household income based on census data reported in 1997 is $40,380, spanning the range of over $56,000 in both the North Slope and Bristol Bay to under $24,000 in Wade Hampton.

[16] Rural Average based on Annual PCE Statistics (FY2000). Urban figures based upon Cooperative Extension Service consumer expenditure survey (2000).

[17] Bethel $2.04 per gallon, March 2000 Cooperative Extension Service Survey; MAFA Estimated weighted average of Weatherization Rural Fuel Price Survey (2000) plus rural communities not covered by survey.

[18] Includes $4.50 per month customer charge

[19] Engineering calculations of aggregate household electrical energy use could improve from roughly 6.7kWh/sq ft/year to around 4.5kWh/sq ft/year if rural households adopted a number of the end-use energy efficiency measures identified in the study— including switching from electrical hot water heaters to efficient oil-fired water heaters.

Of the total rural Alaska household consumption of approximately 17,500,000 gallons a year, there appears to be a 10 percent *potential savings* due to end-use efficiency (including fuel switching).[20]

Some of that potential savings is being realized every year as households periodically replace existing inefficient lighting, appliances, fixtures and heaters with new, mostly more efficient ones.

The challenge is to develop programs that cost-effectively accelerate the replacement of existing inefficient items with newer, more efficient items without creating a net efficiency loss for the utility that may experience a short-term reduction in system efficiency due to decreased demand on generation systems sized for larger demand.

With that in mind, we conducted a small sample end-use survey of rural households, analyzed data from the AHFC weatherization program, and interviewed business people providing energy appliances and energy services to rural Alaska along with weatherization program employees and contractors. We examined numerous studies, reports and data from end-use programs, including a few in rural Alaska. In the end, the quantity and quality of rural end-use data remains limited, leaving significant uncertainty as to the potential net benefits of several of the measures identified in the screening report.

Nonetheless, the benefits of new high-efficiency lighting and programs to replace electric water heaters appear to far outweigh the cost, including the potential for “free riders,” short-term declines in utility energy demand and efficiency, and market uncertainty.

In contrast, the benefit/cost ratios of refrigerator replacement, new direct-vent, high-efficiency heaters, and television are positive, but the uncertainty about the benefits of the program compared to existing market trends is significant. As a result, we recommend small pilot programs to better assess the benefits of a specific program compared to market trends absent the new program.

Finally, the relative benefit/cost ratios of other incremental programs remains less attractive based on the limited data and analysis we have been able to conduct. As a result, we do not recommend any new programs in those areas at this time. We do not rule out the possibility that additional data and new analysis may find new or expanded initiatives that provide net economic benefits.

1.5.2 Schools

It appears that approximately 4.1 million square feet of school buildings exist in the PCE-eligible communities in rural Alaska. Based on anecdotal evidence, the average electrical consumption is estimated at 12 kWh/square foot/year. Average heating fuel consumption is estimated at 1.2 gallons/square foot/year.

Thus, in aggregate, rural Alaska school buildings consume approximately:

Electricity	49,200,000 kWh/year	$14.8 million/year
Heating Fuel	5,000,000 gallons/year	$ 7.5 million/year

[20] Engineering calculations of aggregate household heating energy use could improve from roughly 1.14 gallons per sq foot per year to around 1.0 gallon per sq foot per year if rural households switched to high efficiency direct vent heaters for space and water heating. Note that while the *net* effect of switching from electric to oil-fired hot water heaters is positive, the increase in fuel consumption to heat hot water may not be entirely offset by the fuel savings due to more efficient space heating. The net effect is dependent upon housing characteristics and water consumption patterns.

Of the total rural Alaska school facility consumption of approximately 49,200,000 kWh a year, there appears to be a 50 percent *potential savings* due to end-use efficiency.[21]

Of the total rural Alaska household consumption of approximately 5,000,000 gallons a year, there appears to be a 50 percent *potential savings* due to end-use efficiency.[22]

Some of that potential savings is being realized every year as schools periodically replace existing inefficient lighting, appliances, fixtures and HVAC equipment with new, more efficient ones.

Again, like the household market, the challenge is to develop programs that cost-effectively accelerate the replacement of existing inefficient items with newer, more efficient items without creating a net efficiency loss for the utility that may experience a short-term reduction in system efficiency due to decreased demand on generation systems sized for larger demand.

[21] Based on an assessment of Canadian schools from the Yukon Territories where best practices indicate electrical consumption on the order of 6 kWh/square foot/year and heating fuel consumption on the order of 0.6 gallons per square foot per year. While there may be some differences between usage patterns and acceptable performance of school heating systems in the Yukon compared to Alaska, anecdotal evidence from cross-border sporting events suggests the differences between building usage and subsequent primary energy requirements appear to be relatively minor.

[22] Ibid.

Table ES-2. Summary of End-Use Energy Efficiency Technologies & Initiatives

Technology	Existing Market Trend	Incremental Benefits from New Program	New Program Benefit/Cost	Comments
Lighting	1 in 7 rural lights reported to be Compact Florescent Light (CFL) in rural sample. Diffusion appears relatively slow in rural compared to urban areas where relatively inexpensive CFLs are widely available at "box stores." Relative performance of CFLs to other lights may restrain market penetration relative to analysis based on "energy economics" alone	Replacement of inefficient incandescent bulbs with more efficient CFLs can save on the order of $32 per year per bulb Incremental benefits are sufficient to overcome a high percentage of free riders that may participate in the program.	Households = 1.2 To 2.4 Schools = 1.5 To 3.0	Recommend lighting education and light bulb replacement program for households ($350K per year) and schools ($500K per year). School market has higher B/C due to scale efficiencies.
Refrigeration	Rural households sample averages 1.1 refrigerators. Appliance standards and Energy Star program continue to improve efficiency of new refrigerators. Rate of new purchase and resale of older units is unknown.	Replacing an old refrigerator prior to the end of its normal life may save on the order of $100 a year Providing a credit toward the purchase of an Energy Star may provide savings on the order of $15 a year (difference between energy star and new refrigerator that meets appliance standards)	Replace old refrigerator with new Energy Star refrigerator = 1.1 Provide credit toward new energy star refrigerator when household is looking to purchase new refrigerator = 2.6	Recommend pilot program to ascertain the net economic benefits of replacement and upgrade programs. ($200K per year)
Freezers	59% of rural household sample reports a separate freezer. Appliance standards and Energy Star program continue to improve efficiency of new freezers.	The difference in energy efficiency between old freezers and new freezers is relatively modest – may be on the order of $30 per year. Simple break-evens approach 18 years.	Freezer replacement programs did not achieve a benefit/cost ratio in excess of 1.0	Incremental benefits beyond those provided by existing appliance standards appear difficult to achieve. No new program recommended at this time.

Technology	Existing Market Trend	Incremental Benefits from New Program	New Program Benefit/Cost	Comments
Televisions	Appliance standards and Energy Star program have relatively modest effect on this market. Rate of purchase of new more units and resale/continued use of older units is unknown.	Replacing existing sets with new Energy Star sets may save up to $37 per year.	TV replacement program may achieve a benefit/cost of slightly over 1.0	Recommend small pilot program to assess whether free riders can be limited in order to achieve net program benefits. ($50K/year)
Propane Range (Oven + Cook Top)	Unknown	Replacing electric range with propane range can yield significant energy efficiency savings depending upon kitchen cooking practices and building ability to handle increased moisture load (ventilation/vapor barrier issues). Energy savings benefits may be offset by decline in indoor air quality.	On the basis of direct energy savings, may be able to achieve benefit cost ratio on the order of 2.0 – 3.0	Better understanding of indoor air quality implications may be warranted prior to recommendations to replace electric ranges with propane ranges
Direct Vent Oil-Fired Space Heaters	44% of rural sample households reported installation of high efficiency direct vent oil-fired space heaters. Vendors report brisk sales to rural Alaska.	Significant potential incremental benefits **if** free riders can be limited Replacement of pot burner/cook stove with high efficiency unit may save on the order of $600-700 per year Replacement of typical central boiler with high efficiency unit may save on the order of $200 per year	Replacement of pot burners, cook stoves, and typical central boilers may achieve benefit/cost ratios of between 1.1 – 1.3	Recommend pilot program to assess whether free riders can be limited and net positive benefits achieved. ($200K per year)
Replace Electric Water Heaters with efficient Oil-Fired Water Heaters	52% of rural sample households report *hot water heaters*. 43% of households with water heater report *electric* hot water heaters. Vendors report relatively slow sales of efficient oil-fired hot water heaters	Replacing electric tank hot water heater with oil fired tank hot water heater may save on the order of $800 per year for equivalent hot water output. Risk of free riders appears relatively modest.	Replacement of electric hot water heaters with oil fired hot water heaters may yield benefit/cost ratios in the range of 3-5	Recommend electric hot water heater education and replacement program. ($2 million per year)

Technology	Existing Market Trend	Incremental Benefits from New Program	New Program Benefit/Cost	Comments
Insulation/Weatherization	Current program covers roughly 1500 households per year New housing stock continues to improve due to higher energy efficiency standards	Difficult to assess the incremental benefit of a new program compared to existing programs Increased funding of existing program may yield net benefits depending upon quantification of house life extension value		No new program recommended at this time.
Water Conservation Devices	Unknown in rural Alaska. Evidence from program evaluations in lower 48 suggest a large number of water conservation devices are replaced due to customer dissatisfaction with performance	Undetermined	Undetermined	Given significant level of investment into new water systems for rural Alaska, it may be prudent to conduct a small pilot study to ascertain whether low flow devices meet customer satisfaction criteria
Model Energy Code – Schools	Conversations with SOA DOE facilities staff suggest little activity is occurring due to lack of funding	Significant potential to improve end-use energy efficiency in rural schools. Best practices in Yukon suggest energy savings on the order of 50% may be achievable.	Relatively low cost and high potential for energy savings in new facilities could yield benefit/cost ratio in excess of 2	Recommend development of a model energy code for rural schools ($100K)
Model Energy Code – Housing	HUD Model Energy Code Non-HUD homes			Unable to assess the incremental improvements that a model code would provide over HUD energy codes

Source: End-Use Efficiency Chapter

2 Policy Assumptions

The recommendations and supporting analysis of the rural Alaska energy plan are based on the following policy assumptions:

- The overall level of government funding will be sufficient to cover recommended investments that are likely to yield net economic benefits.
- Government funding is designed to complement, not displace, private sector capital.[23]
- Without new government funding, many energy efficiency measures are currently being adopted in the marketplace today and will continue to be adopted. New programs are conceptually designed to cost-effectively accelerate the replacement of existing inefficient energy systems with newer, more efficient energy systems.
- Supply side energy efficiency programs should be designed to accelerate market replacement of inefficient systems without creating a net efficiency loss due to a short-term reduction in system efficiency caused by decreased demand on generation systems optimally sized for larger demand.
- The economic analysis uses a 5 percent real discount rate and limits the time horizon to 15 years.
- The point of view of Alaskan residents is adopted for the economic analysis.
- The distribution of economic benefits includes households, utilities, and the PCE program. It is assumed that the net economic benefits that are initially distributed to utilities and the PCE program will flow through to Alaskan residents.

[23] For a program implementation example, the Alaska Energy Authority request for energy cost reduction proposals process has established grant-funding guidelines that require a local cost share component. For that program through December, 2003, out of a total project cost of $12.3 million, $5.3 million has been grant funds and $7.0 million has been local cost share—or approximately 43 percent grant and 57 percent local match.

3 Background

3.1 Goal

The goal of the Rural Alaska Energy Plan is to identify initiatives that are likely to produce *cost-effective* improvements in the efficient and reliable delivery of electrical and heating energy in Rural Alaska markets from the point of view of the citizens of the State of Alaska.

3.2 What's Included

In this analysis, an attempt is made to capture the total quantifiable *energy* costs and total quantifiable *energy* benefits that accrue to *all* the citizens of the State of Alaska, as utility ratepayers and heating fuel purchasers, and in their role as federal and state taxpayers. Thus, costs not typically included in the *price* of electricity—the incremental costs of a new diesel fuel tank farm funded primarily by State and Federal government grants—are included in the analysis where relevant.

3.3 Who's Included

For the purposes of this report, rural Alaska is defined as communities eligible to participate in the State of Alaska Power Cost Equalization (PCE) program. Thus the addressable rural market approaches 30,000 residential households with approximately 20 million ft^2 and a total population approaching 80,000 Alaskans.[24] The addressable market also includes nearly 1,700 community facilities (sewer/water facilities, outdoor lighting, community buildings) and 600 school buildings with approximately 4.1 million ft^2.[25]

The communities range in size from small villages with less than 50 people:

- Stony River 35
- Pedro Bay 36
- Umnak 39
- Karluk 41
- Platinum 43
- Red Devil 44

to communities with over 2,000 residents:

- Cordova 2,435
- Dillingham 2,546
- Craig 2,809
- Kotzebue 2,932
- Nome 4,021
- Unalaska 4,178
- Bethel 5,471

[24] See Alaska Census 2000, by Community and Housing Stock Estimates.

[25] See State Department of Education School Inventory screened for PCE eligible communities.

4 Appendices

Figure ES-1. Rural Alaska Energy Plan Summary

		1	2	3	4	5	6	7	8	9
		2003	2004	2005	2006	2007	2008	2009	2010	2011
Investment										
Diesel System Efficiencies		$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000				
Combined Heat & Power		$750,000	$600,000	$600,000	$600,000	$600,000				
Wind Energy Development		$633,000	$5,583,000	$8,584,000	$7,050,000	$7,050,000				
End Use Efficiencies		$2,300,000	$2,800,000	$2,800,000	$2,800,000					
Management, Operations & Maintenance		$250,000	$250,000	$250,000	$250,000	$250,000				
	Totals	$7,933,000	$13,233,000	$16,234,000	$14,700,000	$11,900,000				
5.0% Present Value		$54,999,187								
Returns										
Incremental Efficiency Improvements:										
Diesel System Efficiencies		$0	$289,022	$591,858	$909,006	$1,240,985	$1,588,326	$1,951,579	$2,331,313	$2,728,114
Combined Heat & Power		$0	$51,224	$101,839	$151,851	$201,266	$250,089	$298,328	$345,988	$393,076
Wind Energy Development		$0	$750,774	$1,512,846	$2,286,545	$3,072,140	$3,133,695	$3,193,176	$3,253,786	$3,315,546
End Use Efficiencies		$231,038	$445,121	$689,240	$948,664	$1,224,129	$1,516,404	$1,627,488	$1,744,355	$1,867,269
Management, Operations & Maintenance		$100,000	$200,000	$300,000	$400,000	$500,000	$500,000	$500,000	$500,000	$500,000
	Totals	$331,038	$1,736,142	$3,195,783	$4,696,067	$6,238,520	$6,988,515	$7,570,572	$8,175,442	$8,804,005
5.0% Present Value of Savings		$67,645,684								
Evaluation:										
Benefit/Cost		1.23								
5.0% Net Present Value		$12,646,497								

Figure ES-2. Rural Alaska Energy Plan Diesel Efficiency Improvement Program: Metering, Distribution Efficiencies, Controls, New Generating Units

		1	2	3	4	5	6	7	8	9	10
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Investment											
		$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000					
5.0%	Present Value	$17,317,907									
Returns											
	Base Case:										
2.9%	kWh sold (millions)	400	412	424	436	448	461	475	489	503	517
0.1%	kWh sold per gallon	14.10	14.11	14.13	14.14	14.16	14.17	14.18	14.20	14.21	14.23
	Gallons	28,368,794	29,162,327	29,978,056	30,816,603	31,678,606	32,564,721	33,475,623	34,412,004	35,374,577	36,364,076
$1.25	Fuel Cost	$35,460,993	$36,452,909	$37,472,571	$38,520,754	$39,598,258	$40,705,902	$41,844,528	$43,015,004	$44,218,221	$45,455,095
	Incremental Efficiency Improvements:										
	kWh sold (millions)	400	412	424	436	448	461	475	489	503	517
0.9%	kWh sold per gallon	14.10	14.23	14.35	14.48	14.61	14.75	14.88	15.01	15.15	15.20
	Gallons	28,368,794	28,931,109	29,504,570	30,089,398	30,685,819	31,294,061	31,914,359	32,546,953	33,192,086	34,037,274
	Fuel Cost	$35,460,993	$36,163,887	$36,880,713	$37,611,748	$38,357,273	$39,117,576	$39,892,949	$40,683,691	$41,490,107	$42,546,593
	Incremental Fuel Savings	$0	$289,022	$591,858	$909,006	$1,240,985	$1,588,326	$1,951,579	$2,331,313	$2,728,114	$2,908,502
5.0%	Present Value of Savings	$18,206,169									
	Evaluation:			16	17	18	19	20			
	Benefit/Cost	1.05		0.92	0.98	1.04	1.10	1.15			
5.0%	Net Present Value	$888,262									

Figure ES-3. Rural Alaska Energy Plan Combined Heat and Power Improvement Program

		1	2	3	4	5	6	7	8	9	10
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
	Investment										
	Template Agreement	$50,000									
	Design Guidelines	$100,000									
	Microgrant Incentive Program	$100,000	$100,000	$100,000	$100,000	$100,000					
	System Improvement Grants	$500,000	$500,000	$500,000	$500,000	$500,000					
	$630,000	$750,000	$600,000	$600,000	$600,000	$600,000					
5.0%	Present Value	$2,740,543									
	Returns										
	Base Case:										
	Heated Space (Sq Footage)	4,000,000									
	BTU req'd/sq ft/yr	115,920									
	Heating System MMBTUs	463,680	463,680	463,680	463,680	463,680	463,680	463,680	463,680	463,680	463,680
0.2%	BTU sold/gallon	96,600	96,793	96,987	97,181	97,375	97,570	97,765	97,961	98,156	98,353
	Gallons	4,800,000	4,790,419	4,780,857	4,771,315	4,761,791	4,752,287	4,742,801	4,733,334	4,723,887	4,714,458
$1.35	Fuel Cost	$6,480,000	$6,467,066	$6,454,158	$6,441,275	$6,428,418	$6,415,587	$6,402,781	$6,390,001	$6,377,247	$6,364,518
	Incremental Efficiency Improvements:										
	Heating System MMBTUs	463,680	463,680	463,680	463,680	463,680	463,680	463,680	463,680	463,680	463,680
1.0%	BTU sold/gallon	96,600	97,566	98,542	99,527	100,522	101,528	102,543	103,568	104,604	105,650
	Gallons	4,800,000	4,752,475	4,705,421	4,658,833	4,612,706	4,567,035	4,521,817	4,477,047	4,432,719	4,388,831
	Fuel Cost	$6,480,000	$6,415,842	$6,352,318	$6,289,424	$6,227,153	$6,165,498	$6,104,453	$6,044,013	$5,984,171	$5,924,922
	Incremental Fuel Savings	$0	$51,224	$101,839	$151,851	$201,266	$250,089	$298,328	$345,988	$393,076	$439,596
5.0%	Present Value of Savings	$3,090,593									

	Evaluation:			Delta			
	Benefit/Cost	1.13		0.6%	0.8%	1.0%	1.2%
5.0%	Net Present Value	$350,049		0.85	1.13	1.40	1.66

Figure ES-4. Rural Alaska Energy Plan Wind Systems

		1	2	3	4	5	6	7	8	9
		2003	2004	2005	2006	2007	2008	2009	2010	2011
Investment										
	Detailed Site Reconnaisance	$400,000	$400,000	$400,000						
	Final Feasibility Reviews	$133,000	$133,000	$134,000						
	Design/Build RFP, Contract Admin	$100,000	$50,000	$50,000	$50,000	$50,000				
	Design/Build Contract		$5,000,000	$8,000,000	$7,000,000	$7,000,000				
		$633,000	$5,583,000	$8,584,000	$7,050,000	$7,050,000				
5.0%	Present Value	$24,405,897								
Returns										
	Base Case:									
	Fuel Savings from Wind Without Wind Resource Development Program									
2.0%	kWh generated displaced	1,100,000	1,122,000	1,144,440	1,167,329	1,190,675	1,214,489	1,238,779	1,263,554	1,288,825
0.10%	kWh generated/gallon	13.41	13.42	13.44	13.45	13.46	13.48	13.49	13.50	13.52
	Gallons	82,034	83,591	85,178	86,794	88,442	90,121	91,831	93,574	95,350
$1.25	Fuel Cost	$102,542	$104,489	$106,472	$108,493	$110,552	$112,651	$114,789	$116,968	$119,188
	Incremental Benefit of Wind Resource Development Program									
2.0%	kWh generated displaced	1,100,000	9,100,000	17,100,000	25,100,000	33,100,000	33,762,000	34,437,240	35,125,985	35,828,504
0.10%	kWh generated/gallon	13.41	13.30	13.20	13.10	13.00	13.00	13.01	13.03	13.04
	Gallons	82,034	684,211	1,295,455	1,916,031	2,546,154	2,597,077	2,646,372	2,696,603	2,747,787
$1.25	Fuel Cost	$102,542	$855,263	$1,619,318	$2,395,038	$3,182,692	$3,246,346	$3,307,965	$3,370,754	$3,434,734
	Incremental Fuel Savings	$0	$750,774	$1,512,846	$2,286,545	$3,072,140	$3,133,695	$3,193,176	$3,253,786	$3,315,546
5.0%	Present Value of Savings	$26,784,217								
	Evaluation:									
	Benefit/Cost	1.10								
5.0%	Net Present Value	$2,378,320								

Figure ES-5. Rural Alaska Energy Plan End Use Efficiency

			1	2	3	4	5	6	7	8	9
			2003	2004	2005	2006	2007	2008	2009	2010	2011
Investment											
		Households									
		Lighting Replacement	$350,000	$350,000	$350,000	$350,000					
		Refrigerator Replace/Upgrade Pilot	$200,000	$200,000	$200,000	$200,000					
		Inefficient TV Replacement Pilot	$50,000	$50,000	$50,000	$50,000					
		Space Heating Replacement Pilot	$200,000	$200,000	$200,000	$200,000					
		Replace Electric Hot Water Heaters	$1,500,000	$2,000,000	$2,000,000	$2,000,000					
		Subtotal Households	$2,300,000	$2,800,000	$2,800,000	$2,800,000					
		Schools									
		Lighting Replacement	$500,000	$500,000	$500,000	$500,000					
		Model Energy Code	$100,000								
		See also CHP - Design Guidelines									
		Subtotal Schools	$600,000	$500,000	$500,000	$500,000					
		Total	$2,900,000	$3,300,000	$3,300,000	$3,300,000					
	5.0%	Present Value	$11,320,684								
		Rural Alaska Household Market - Base Case									
	1.5%	Households	25,000	25,375	25,756	26,142	26,534	26,932	27,336	27,746	28,162
5040	2.0%	kWh/household/year	5,141	5,244	5,348	5,455	5,565	5,676	5,789	5,905	6,023
		Electricity - kWhs	128,520,000	133,056,756	137,753,659	142,616,364	147,650,721	152,862,792	158,258,848	163,845,386	169,629,128
	$0.31	$/household - kWhs	$1,594	$1,626	$1,658	$1,691	$1,725	$1,760	$1,795	$1,831	$1,867
700	1.0%	gallons/household/year	707	714	721	728	736	743	750	758	766
		Heating Fuel - gallons	17,675,000	18,119,526	18,575,232	19,042,399	19,521,316	20,012,277	20,515,586	21,031,553	21,560,496
	$2.00	$/household - Heating Fuel	$1,414	$1,428	$1,442	$1,457	$1,471	$1,486	$1,501	$1,516	$1,531
		TOTAL $/household	$3,008	$3,054	$3,100	$3,148	$3,196	$3,246	$3,296	$3,347	$3,398
		TOTAL ANNUAL EXPENDITURES	$115,032,400	$118,734,241	$122,557,734	$126,506,944	$130,586,079	$134,799,485	$139,151,657	$143,647,244	$148,291,052
		Rural Alaska School Facility Market - Base Case									
	1.0%	Square Footage of Facility	4,150,000	4,191,500	4,233,415	4,275,749	4,318,507	4,361,692	4,405,309	4,449,362	4,493,855
12.0	0.5%	kWh/sq ft/year	12.1	12.1	12.2	12.2	12.3	12.4	12.4	12.5	12.6
		kWhs/year	50,049,000	50,802,237	51,566,811	52,342,892	53,130,652	53,930,268	54,741,919	55,565,785	56,402,050
	$0.31	$/year - electricity	$15,515,190	$15,748,694	$15,985,711	$16,226,296	$16,470,502	$16,718,383	$16,969,995	$17,225,393	$17,484,635
1.20	0.5%	gallons/sq ft/year	1.21	1.21	1.22	1.22	1.23	1.24	1.24	1.25	1.26
		gallons/year	5,004,900	5,080,224	5,156,681	5,234,289	5,313,065	5,393,027	5,474,192	5,556,578	5,640,205
	$1.50	$/year - fuel	$7,507,350	$7,620,336	$7,735,022	$7,851,434	$7,969,598	$8,089,540	$8,211,288	$8,334,868	$8,460,307
		TOTAL ANNUAL EXPENDITURES	$23,022,540	$23,369,029	$23,720,733	$24,077,730	$24,440,100	$24,807,923	$25,181,283	$25,560,261	$25,944,943

Returns											
		Incremental Benefit of End-Use Efficiency Programs							1.9%		
		Households							1.0%		
5,040	1.0%	Electricity - kWh/household/year	5,090	5,141	5,193	5,245	5,297	5,350	5,452	5,555	5,661
700	1.5%	Fuel - gallons/household/year	711	721	732	743	754	765	773	781	789
		Electricity - $/year	$39,450,600	$40,442,783	$41,459,919	$42,502,636	$43,571,577	$44,667,402	$46,198,824	$47,782,751	$49,420,982
		Fuel - $/year	$35,525,000	$36,598,743	$37,704,940	$38,844,572	$40,018,649	$41,228,213	$42,265,102	$43,328,070	$44,417,771
								0.1%			
		School Facilities						0.1%			
12.0	0.4%	Electricity - kWh/sq ft/year	12.0	12.1	12.1	12.2	12.2	12.3	12.3	12.3	12.3
1.20	0.5%	Fuel	1.21	1.21	1.22	1.22	1.23	1.24	1.24	1.25	1.26
		Electricity - $/year	$15,499,752	$15,717,369	$15,938,040	$16,161,810	$16,388,722	$16,569,162	$16,751,589	$16,936,024	$17,122,489
		Fuel - $/year	$7,507,350	$7,620,336	$7,735,022	$7,851,434	$7,969,598	$8,089,540	$8,211,288	$8,334,868	$8,460,307
		Electricity Savings	$406,038	$804,812	$1,243,716	$1,708,437	$2,200,147	$2,720,063	$2,861,419	$3,009,319	$3,164,047
		Fuel Savings	($175,000)	($359,691)	($554,475)	($759,773)	($976,018)	($1,203,659)	($1,233,931)	($1,264,964)	($1,296,778)
		TOTAL ANNUAL SAVINGS	$231,038	$445,121	$689,240	$948,664	$1,224,129	$1,516,404	$1,627,488	$1,744,355	$1,867,269
	5.0%	Present Value of Savings	$15,282,976								
		Evaluation:									
		Benefit/Cost	1.35								
	5.0%	Net Present Value	$3,962,292								