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Pacific Northwest National Laboratory
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U.S. Department of Energy

Payette Idaho Pool Energy Conservation Study

L. L. Larson
T. C. Hillman
J. J. McCullough
N. D. Roy

November 2001

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RL01830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Executive Summary

Payette, Idaho, is a small community located approximately 70 miles east of Boise, near the Idaho/Oregon border. One of the highlights of Payette is its community pool complex, consisting of two outdoor pools and an indoor pool. The pool facility is located at the Payette City Park and is an important element of the city's recreational facilities. Seeking alternatives to manage escalating costs, Payette took advantage of its partnership in the U.S. Department of Energy's (DOE's) Rebuild America Program and requested outside assistance through its Idaho State representatives. Pacific Northwest National Laboratory (PNNL), one of DOE's multi-program national laboratories, was tasked to provide assistance. The objective of the study was to identify methods to lower the cost of operation, to lower energy consumption, and to create a more pleasant environment within the pool facility.

The indoor pool is an important community gathering place and is used year round for general swimming and organized activities such as water aerobics. The building walls on the indoor pool, consisting of a series of large panels, can be removed during warm weather, making it a third outdoor pool.

Staff at PNNL analyzed a number of energy-conservation opportunities for the Payette City Pool. The conservation opportunities analyzed included adding pool covers, adding a solar water-heating system, sealing and insulating the building envelope, optimizing the pool schedule, incorporating low-flow showerheads and faucet aerators, insulating hot-water pipes, and setting back the water-heater temperature. These energy-saving opportunities are summarized below and discussed in detail in Section 4.0, Energy Conservation and Retrofit Options.

The three most significant areas of savings resulting from the analysis are adding pool covers, adding solar water-heating systems, and sealing and insulating the building envelope.

Two types of pool covers were examined. From a life-cycle-cost perspective, pool covers clearly stand out as a simple, easy-to-implement energy and cost-savings measure. Pool covers can save from $3,000 to $14,000 annually, resulting in simple paybacks in less than 1.5 years.

Solar water-heating systems (unglazed and glazed) were also analyzed and found to be life-cycle cost effective. The unglazed has a savings from approximately $4,000 to $13,000 annually, depending on the collector area, and a typical simple payback of about 5.5 years.

Assuming that the building is enclosed and reasonably sealed, three insulation options were examined. The three options are similar and would result in a savings of approximately $16,000.

In addition, several "no-cost low-cost" opportunities that would result in measurable savings were identified. Additional opportunities exist by modifying the indoor pool building structure using alternative construction materials, adding insulation, and improving the control of infiltration and ventilation air.

Acknowledgments

The authors gratefully acknowledge the assistance provided by Paul Stevens, Payette City Engineer, and John Frank, Payette City Clerk. Their time, effort, and valuable assistance in familiarizing Pacific Northwest National Laboratory staff with the City Park pool plant systems and operations and for providing the numerous technical resources, are sincerely appreciated.

We also thank the Mayor and City Council of Payette for taking their valuable time to speak with us. We appreciate the Council relating to us the importance the community places on the Payette City Park pools and on the Council's commitment to a better, more cost-effective pool for its constituents.

In addition, the authors thank Rosemarie Bartlett, Shannan Butler, Bob Dahowski, Merry Loew, and Rita Pool, all of Pacific Northwest National Laboratory, for the conscientious, team-oriented, and high-quality assistance they brought to the study.

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JJ McCullough
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ND Roy

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1.0 Introduction

The Payette City Pool is located at the Payette, Idaho, City Park. The complex consists of three gas-heated pools: an indoor swimming pool, an outdoor swimming pool, and an outdoor wading pool. The walls enclosing the two long sides of the pool building can be removed during warm weather, making it a third outdoor pool.

Staff at Pacific Northwest National Laboratory (PNNL) studied and performed evaluations on the pool facility for energy-conservation measures and actions to lower the annual energy costs of the pool complex. PNNL staff analyzed the utility billing data and a number of energy-conservation opportunities. Conservation opportunities analyzed include adding pool covers and a solar water-heating system, sealing and insulating the building envelope, optimizing the pool schedule, and incorporating several no- or low-cost energy-saving recommendations.

2.0 Facility Description

The Payette City Pool was constructed in 1973. The complex consists of one indoor and two outdoor pools, one of which is a shallow wading pool. The three pools are heated with a single 1.16 million Btu/h (Mbtu/h) natural gas-fired boiler. There are two circulation pumps, one for the indoor pool and one for the outdoor pools. Each pump is 7.5 h.p. and operates 24 hours per day during the pools' respective operating seasons.

2.1 Physical Data

	Dimensions (ft)	Surface Area (ft^2)	Volume (gal)
Indoor Pool	75 x 42	3150	147,000
Outdoor Pool	75 x 36	2700	136,000
Wading Pool	36 x 15	540	9,000
Total		6390	292,000

Building Area[(a)]	7,681 ft^2	
Total Roof Surface Area[(a)]	16,348 ft^2	
South Facing Roof Surface Area[(a)]	8,174 ft^2	
Exposed Wall Area[(a)]	2,890 ft^2	(2190 ft^2-Kalwall? , 700 ft^2 concrete block)

(a) Only encompasses the structure that houses the indoor pool, i.e., not the showers or locker room area.

2.2 Mechanical Data

Heat Source	Heat Capacity	Temperature Setting	Circulation Pump
Natural Gas	1.16 Mbtu/h	80?F	7.5 h.p. (indoor pool)[a] - 7.5 h.p. (outdoor pools)[b]

(a) 24 hours per day operation, year round.
(b) 24 hours per day, only during summer operation.

2.3 Hours of Operation

The pool facility is operated year round by the City of Payette. All three pools are open during the summer from approximately May 30 until September 5. Only the indoor pool is open for operation during the winter.

Many different groups in the community use the pool for various activities, including swimming lessons, open-lap swimming, and a variety of classes. Local swim teams also use the pool for practices and swim meets.

Summer Operation – All Pools (5/30–9/5)

	Mon	Tues	Wed	Thursday	Friday	Saturday	Sunday
Open	5:30am	5:30am	5:30am	5:30am	5:30am	1:00pm	1:00pm
Close	9:00pm	9:00pm	9:00pm	9:00pm	9:00pm	9:00pm	9:00pm

Winter Operation – Indoor Pool Only (9/6–3/25)

	Mon	Tues	Wed	Thursday	Friday	Saturday	Sunday
Open	6:00am	6:00am	6:00am	6:00am	6:00am	1:00pm	Closed
Close	9:00pm	9:00pm	9:00pm	9:00pm	12:30pm	4:00pm[a]	Closed
(a) 3/26 to 5/29 stays open until 9 pm.							

3.0 Utility Bill Analysis

The City of Payette staff provided electric, natural gas, and water-utility data. The data were examined for trends and anomalies and were used in the assessment and economic analyses. Graphs for the electric and natural-gas cost/consumption data are included in this report with a brief discussion of observations. The applicable City of Payette Electric and Gas Utility Rate schedules are shown in Appendix A. Detailed utility cost breakdowns are available in Appendix B.

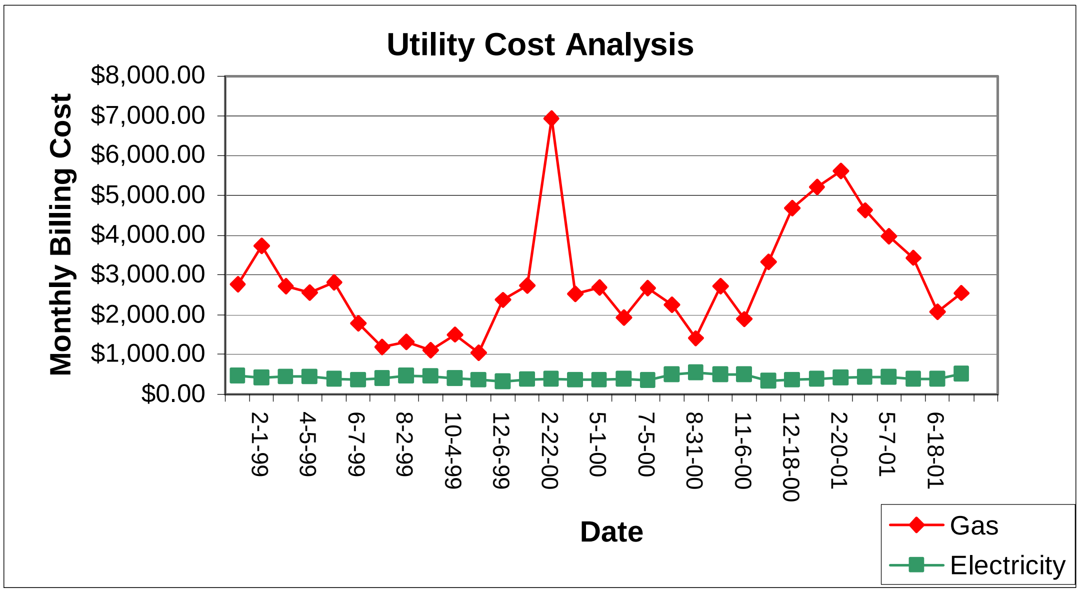


Figure 3.1. Total Energy Costs for the Pool Facility from Jan. 1999 to Aug. 2001

The operation of the Payette City Pool consumed 57,361 therms of natural gas and 151,364 kWh of electricity, equating to a total energy purchase of $41,733 in 2000.

Two issues stand out from the utility bill natural gas data as illustrated in Figure 3.1—the anomalous reading in February 2000 and a significantly greater cost of operation during the winter of 2001 compared to the prior two years. Both issues are examined further below. Discussions of electric utility bills, consumption, and demand also follow.

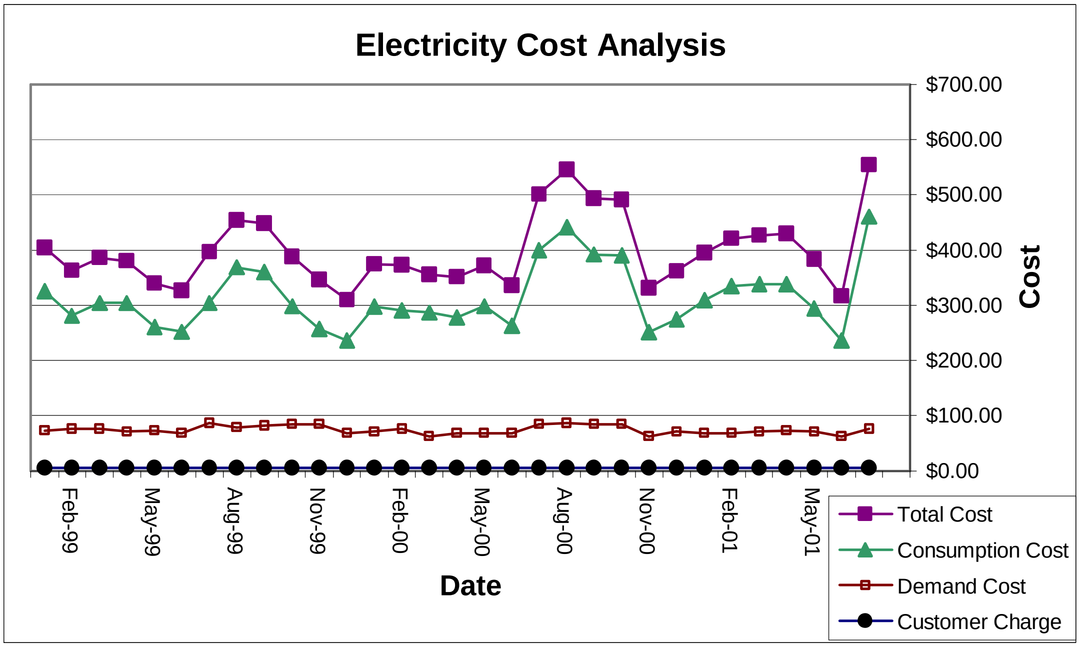


Figure 3.2. Individual Components of the Electric Charges

As shown in Figure 3.2, electric costs appear to directly correlate with consumption. Although the correlation exists, it is due to a change in the rate ($/kWh) and the addition of the basic load capacity (BLC) charge. Annually, electric consumption is flat over the period examined. The large increase in electric cost for July 2001 is because of a rate increase of over 60% in electric usage cost (kWh).

The customer charge is a fixed cost that does not provide a cost-savings opportunity. The demand cost is flat and minor relative to consumption.

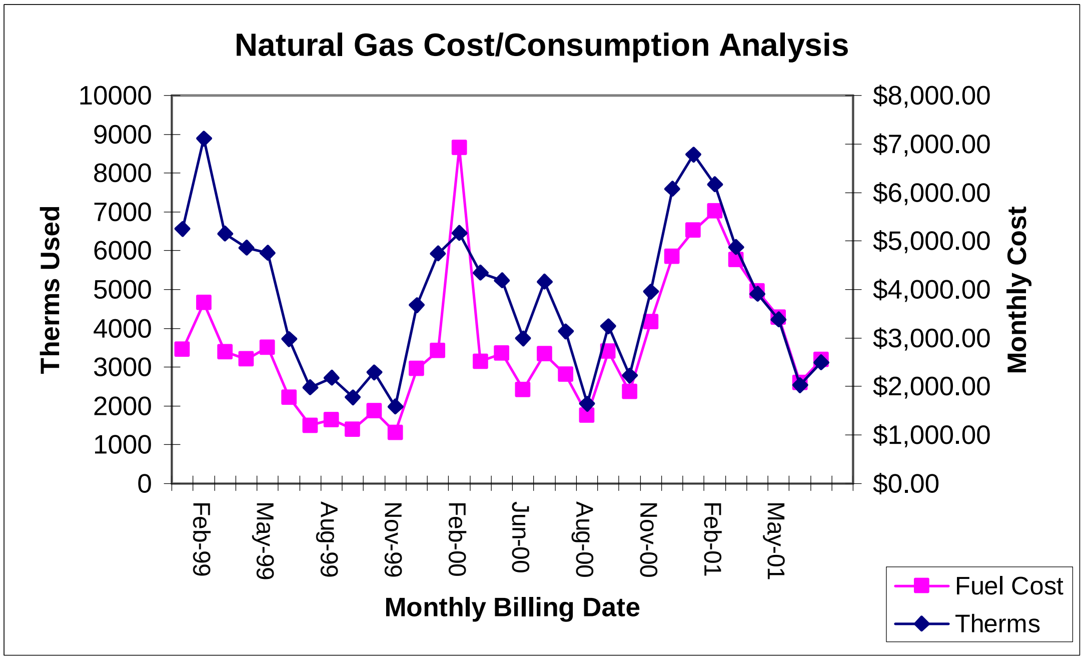


Figure 3.3. Represents the Natural Gas Consumption and Cost

Note in Figure 3.3 that the fuel cost for February 2000 does not appear to be in line with the other billings and cannot be accounted for based on consumption. We are unable to determine if there was a temporary, one-month increase in the cost per therm or if there may have been an incorrect billing. The City should further investigate with their gas supplier to obtain confirmation. If an error was made, it would appear that the error is in favor of the City.

Fuel usage and costs in the 2001 winter trended higher than the previous two years, contributing to the significantly higher utility bills in that time period as illustrated in Figure 3.1.

During the summer months, all three pools are in use and cost about $2,000 a month to operate. During the winter months, only the indoor pool is in use, and yet it costs over $5,000 a month to operate. Although energy and cost savings opportunities exist for all three pools, the indoor pool presents the largest opportunity.

Since natural gas is the largest component of total utility cost, opportunities aimed at reducing natural gas consumption would have the biggest impact on cost.

4.0 Energy Conservation and Retrofit Options

PNNL staff analyzed four major energy-conservation and retrofit options for the Payette City Pool: adding pool covers, adding a solar water-heating system, sealing and insulating the building envelope, and implementing no- and low-cost maintenance and operations options. The maintenance and operations energy-savings options include optimizing the pool schedule, incorporating low-flow showerheads and faucet aerators, insulating hot-water pipes, and setting back the water-heater temperature (discussed in Section 5.0). Costs used in the analyses are expected marketplace values and may vary by supplier. The pool covers and solar collectors were analyzed using the Energy Smart Pools Software. See Appendix C for Energy Smart Pools Software specifications. Building sealing and insulating options were analyzed using the Facility Energy Decision System (FEDS) software. See Appendix D for more information on FEDS. Life-cycle cost methodology was used for analyses, and examples are provided in Appendix E.

4.1 Pool Covers

Both vinyl and insulated pool covers were examined. A vinyl pool cover is any heavy-duty sheet cover and has an R-value significantly less than 1. An insulated pool cover has insulation material between two layers of vinyl and has an R-value of 2.0. Pool covers have a moderate up-front cost compared to the savings that are realized. While the initial disruption of pool routine to adjust to putting the cover on every night and removing it every morning can be an inconvenience, the low maintenance and immediate savings show a desirable trade off. Automatic and semi-automatic systems that extend and retract covers were not analyzed.

Using either pool cover realizes energy savings that result from reduced evaporation from the pool. Table 4.1 illustrates the energy-savings results from adding pool covers to the indoor, the outdoor, and all three pools. The Cost/sf column describes the cost of the cover per square foot of pool area covered. This in turn is translated into the Total Cost of the cover. Energy Savings is measured in therms and these data are then translated into dollars saved (Savings) annually. The Payback column illustrates how many years (or portion of a year) the cover would need to be used to pay for itself with the savings earned.

Table 4.1. Pool Covers

		Cost/sf	Total Cost	Energy Savings (therms)	Savings	Payback (years)
Indoor	Vinyl	$1.07	$3,377	13,145	$10,779	0.31
	Insulated	$1.47	$4,643	13,145	$10,779	0.43
Outdoor	Vinyl	$1.07	$3,474	3,691	$3,027	1.15
	Insulated	$1.47	$4,776	4,083	$3,348	1.43
All pools	Vinyl	$1.07	$6,851	16,836	$13,806	0.50
	Insulated	$1.47	$9,420	17,228	$14,127	0.67

With the indoor pool, the vinyl cover is a less expensive first-cost alternative to the insulated cover with the same energy savings being realized. The outdoor pool shows that although the insulated pool cover gave an annual energy savings of $321 more than the vinyl cover, the insulated cover was $1302 more in up-front costs and therefore has a longer payback than the vinyl cover. Putting covers on all of the swimming pools shows the greatest overall energy savings with both the vinyl and the insulated pool covers being very effective. Of course, a combination of insulated pool covers on the outside pools and vinyl on the indoor pool is also an option. The vinyl on the indoor pool would be a cost savings of $10,779, and the insulated on the outdoor pools would constitute a savings of $3,348. These would combine for an annual savings of $14,127—the same as if they were all insulated.

4.2 Solar Water-Heating System

Two types of solar water-heating systems are used in the industry, glazed and unglazed. Glazed systems are much more expensive, about three times the cost of unglazed, but are capable of heating year round even in areas that reach freezing conditions. Glazed systems are also more complex in design, thus requiring additional maintenance. Unglazed systems are less expensive, but can only be used in the absence of frost, typically during summer months. These systems should be viewed as representative of the current technology. This analysis is intended to be the first step in a more detailed analysis of specific solar systems that considers space availability, placement, orientation, shading, and other information needed for the system.

A number of solar-collector configuration options were analyzed comparing glazed and unglazed collectors over different collector areas. These are summarized in Table 4.2 (Unglazed) and Table 4.3 (Glazed). The numbers in both tables reflect both indoor and outdoor pools.

Table 4.2. Solar Collector Options

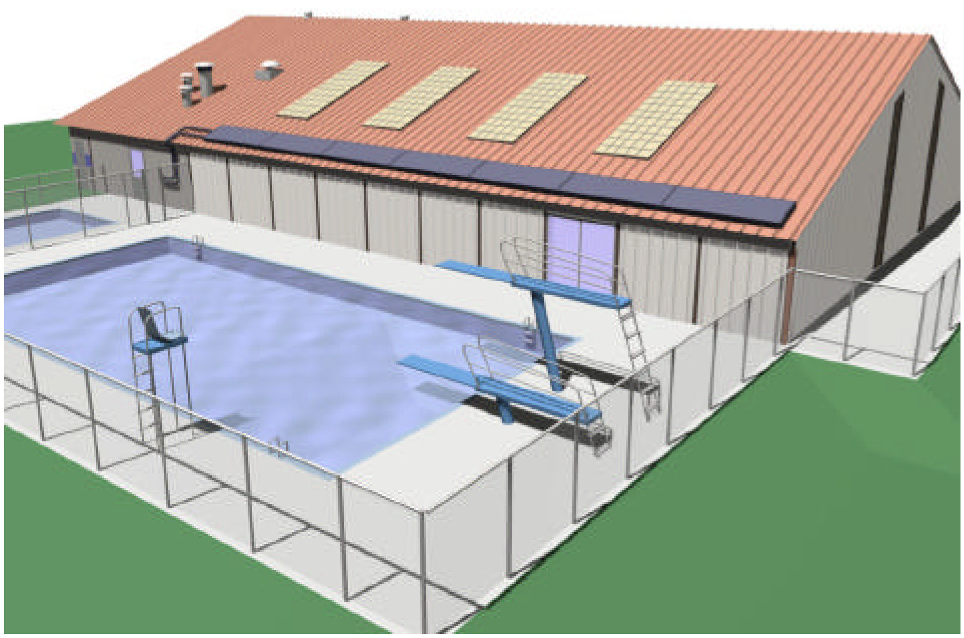
Unglazed						
				Annual Energy Savings		
Total Pool Area (%)	**Collector Area (sf)**	**Cost/sf**	**Total Cost**	**Quantity (therms)**	**Energy Cost Savings**	**Payback (years)**
25	1600	$13.00	$20,800	4,823	$3,955	5.3
35	2240	$13.00	$29,120	7,768	$6,370	4.6
50	3200	$13.00	$41,600	9,528	$7,813	5.3
75	4800	$13.00	$62,400	13,075	$10,722	5.8
100	6400	$13.00	$83,200	15,744	$12,910	6.4

Table 4.3. Solar Collector Options

Glazed						
				Annual Energy Savings		
Total Pool Area (%)	Collector Area (sf)	Cost/sf	Total Cost	Quantity (therms)	Energy Cost Savings	Payback (years)
25	1600	$40.20	$64,320	7,568	$6,206	10.4
35	2240	$40.20	$90,048	10,596	$8,689	10.4
50	3200	$40.20	$128,640	14,935	$12,247	10.5
75	4800	$40.20	$192,960	19,896	$16,315	11.8
100	6400	$40.20	$257,280	22,602	$18,534	13.9

The first column in both tables, Total Pool Area, shows the percentage of pool area that the collector would cover if it were placed onto the pool. In reality, the solar collector would be mounted on the roof of the pool building. The Collector Area in square feet multiplied by the cost per square foot gives the Total Cost of the solar system. The Annual Energy Savings are categorized in both therms and dollars for convenience, and the number of years to pay back the initial cost is calculated in the last column.

Table 4.2 shows the cost savings increase with total pool area covered. The most effective solution by cost versus return on investment is indicated by a 35% pool-area coverage as shown by the lowest payback. Table 4.3 shows that the glazed solar collectors, while able to work more days out of the year, cost more than triple what the unglazed collectors cost with just under twice the energy cost savings and approximately twice the payback time.



The graphic portrays the concept for a roof-mounted solar collector. The actual collector area would be larger, depending on the amount of pool area served.

The State of Idaho offers loan programs that may be available to the City; this could provide a low-cost method to acquire solar water heating systems. For more information on these loan programs, contact:

John Crockett
Idaho Department of Water Resources
Energy Division, Statehouse Mail
1301 North Orchard
Boise, ID 83706
Phone**:** (208) 327-7962
Fax: (208) 327-7866
Web site**:** http://www.idwr.state.id.us/energy/

4.3 Sealing and Insulating the Building Envelope

Using FEDS, a building-simulation, decision-making software for energy efficiency, PNNL staff analyzed a number of options representing different levels of insulating the pool building. (See Appendix D for FEDS specifications.) In these analyses, insulation is added to the roof and walls to lessen heat loss to the environment, thus lowering the air heating requirement in the winter. The installation of the recommended building insulation also would lower the pool heating costs. Sealing and insulating the pool building shows a clear benefit in these simulations. To achieve the maximum savings, the building must be properly sealed to prevent heat loss by infiltration.

Referring back to Figure 3.3, during the winter months, only the indoor pool is in use, yet it costs over $5,000 to operate. The energy used is to heat the indoor pool and the conditioned space. Therefore, sealing and insulating the building would provide savings both in water heating and space heating.

While the option of sealing and insulating the building is very energy efficient, the natural light within the indoor-pool area and the ability to remove the panels between the indoor and outdoor pools during the summer months would be eliminated. This particular concern can be addressed in a number of ways. One solution would be to design the ceiling material to use reflective light instead of direct light. This could be accomplished by hanging large lights from the ceiling that do not shine down directly onto the swimming pool but instead shine onto the ceiling surface that would then reflect a diffused light that reduces glare for swimmers. Skylights, light wells, and light tubes used in conjunction with indoor lighting are another solution that would allow natural light all year round and/or can be opened during the summer months. Some of these daylighting systems are available that are permanently closed or have mechanical mechanisms permitting opening and closing.

A comparison of relative costs and savings for the building-insulation options are summarized in Table 4.4. This analysis modeled the pool structure only and did not include the shower, locker room, and front-desk area. A discussion of separating these areas follows.

Table 4.4. Building Insulation Options

	Cost/sf	Total Cost	Annual Energy Savings (therms)	Savings	Payback (years)
Simple Saver? (R-30)	$1.87	$19,768	21,420	$17,564	1.13
Simple Saver? (R-19)	$1.71	$18,076	20,610	$16,900	1.07
Over-the-Purlin (R-11)	$1.65	$17,442	18,990	$15,572	1.12

Simple Saver? (available in R-30 or R-19) is a type of fiberglass insulation that is placed between the ceiling and the roof of the building. It gives fairly consistent insulation properties throughout the building. The over-the-purlin installation technique uses insulation that is draped over the supports of the building roof. These supports not only support the roof but also have the ceiling attached to it. These supports are called purlins. The R-30 insulation is laid across the purlins and allowed to sag into the space between them. This type of insulation is less expensive, but the insulation properties are inconsistent and therefore a final value of R-11 (rather than R-30) is achieved.

An important consideration in insulating the building envelope is air moisture removal. The code requires that 0.5 cubic feet per minute (cfm) of outdoor fresh air be supplied to the pool area at all times. This number can easily be doubled to 1 cfm supplied and exhausted, to reduce moisture problems in the pool building. Moving that amount of outdoor air is costly and energy consuming. A heat recovery system is recommended to alleviate some of these energy costs. This solution would require a ducted exhaust fan located near the supply duct in place of the three existing fans on the east end of the building.

5.0 No-Cost/Low-Cost Operation and Maintenance Conservation

Optimizing regular operations and enhancements to maintenance routines are effortless to implement and will often result in immediate benefits. Regularly-scheduled maintenance and repair of the building is a simple low-cost solution to immediate and long-term energy and dollar savings.

5.1 Optimize Hours of Operation

Operating the indoor pool in winter is two to three times more costly than operating all three pools in summer. Optimizing the amount of time the facility is occupied or an activity is taking place can improve the energy efficiency of the facility. The annual schedule of operation should be reviewed with the various user groups to see if schedules can be "tightened-up" without undue inconvenience. Decisions where there are conflicts may need to be made at a Council level after weighing the overall goals of the City versus the desires of the users.

Explore ways to increase the number of users during open periods. There are analytical tools and methods that do a reasonable job of quantifying the societal value of services such as a community pool, which can then be compared to the cost of operation. The pools' operation can be optimized based on the relationship of societal value to operating cost. That type of analysis was not performed.

5.2 Low-Flow Showerheads/Faucet Aerators

A number of showerheads and facet aerators are damaged or missing, and the remaining units do not appear to be of the reduced flow type. As part of the normal operations and maintenance of the facility, consider immediate replacement of the existing showerheads with the low-flow type. This is a cost that would be recovered quickly. A variety of styles of showerheads are available that are easily installed, are corrosion resistant, and need less pressure to give the same water flow through the head. Faucet aerators are also available in low maintenance styles that reduce clogging and are corrosion resistant.

5.3 Insulate Domestic Hot-Water Piping

Adding pipe insulation from the main water heater in the mechanical room to the shower/restroom areas where accessible is another low-cost option that would have beneficial results. Once the insulation is in place, there is virtually no maintenance needed except an occasional check to ensure that the insulation is still in place. The Idaho code requires insulation that is at least a ½ inch thick with an R-value of 1.75.

5.4 Verify Water-Heater Temperature Setpoint

As an operations and maintenance activity, verify that the water-heater temperature setpoint is set to no greater than 120º F. Reducing the temperature would reduce standby losses without compromising comfort. This is also an ideal safety measure to prevent accidental injuries from excessive hot-water temperatures.

6.0 Energy Technologies Not Analyzed

Many more energy-efficiency technologies exist than can be addressed in this limited evaluation. Nevertheless, there are technologies that were examined, but not analyzed, that the authors feel should be highlighted.

6.1 Hot Tub

The hot tub, located within the indoor pool building, represents an energy load and cost. Technology and operational changes to improve efficiency and reduce costs were not analyzed. Nonetheless, keeping the hot tub covered when not in use and turning off the water heaters whenever possible would provide measurable savings. A simple and quite effective way to reduce heat loss when the hot tub is unoccupied for a short period of time is to cover it with bubble pack.

6.2 Solar Wall

Transpired solar wall systems are used to preheat and even augment space heating. Solar wall systems were examined and determined not practical for this application. The amount of surface area required for a viable system is considerably more than available. In addition, given the existing configuration for the indoor pool-space heating system, incorporating a solar wall would be difficult.

6.3 Dehumidification

Dehumidification of the indoor pool's heated space was examined, but not analyzed. Outside air used for purging and space heating is dry enough that mechanical dehumidification is not necessary. Implementing mechanical dehumidification would result in a net increase in energy consumption.

6.4 Water Savings

Water-saving opportunities were not analyzed because the City does not bill itself for water. Nonetheless, any water-saving measures implemented would result in a cost savings from reduced need for water-treatment chemicals.

7.0 Non-Energy Related Improvements

Non-energy related improvements are those that are not designed to directly impact short-term energy savings, but would show a return in the long run due to maintenance and operations savings, reducing heating and cooling needs, and eliminating the need for crisis repair work.

7.1 Changes to Building Façade

During the PNNL visit to the pool facility, several Council members expressed a desire to change the façade of the facility. While this may not directly improve the energy efficiency of the facility, we provide the following recommendation should the City elect to upgrade the existing façade.

Exterior Insulating Finish System (EIFS), also known as synthetic stucco, is a multi-layered exterior wall system that is used on both residential and commercial buildings. EIFS provides outstanding energy efficiency and offers quite a bit of design flexibility using color and texture. These systems provide a three-fold benefit:

1. Continuous insulation over the entire building, which, in addition to increased thermal insulation, effectively captures the thermal mass of the concrete masonry unit construction within the building envelope.

2. Design flexibility with architectural details. EIFS provides a great variety of colors, textures, and architectural patterns to increase the aesthetics of the building.

3. Maintains the durability of the indoor surface of the walls.

7.2 Air Conditioning in the Shower/Locker Room Areas

The existing shower/locker room areas are common with the pool area, but are served by a separate natural gas air handler. To provide more control over temperature, humidity, and to some degree mold and mildew, an air-conditioning coil can be added to the existing air handler. The cost to do this is approximately $1200 to $1500 per ton of cooling required. Air conditioning would increase the operating cost, but is a long-term investment in the overall quality of the environment that the users experience.

7.3 Isolate Shower/Locker Room from Pool

Another consideration to adding air conditioning is physically separating the shower/locker room and pool areas. The separation could be glass partitions similar to the aluminum storefront systems typically used in commercial buildings. Sets of double doors can provide a vestibule space to provide a “buffer” between the two areas. This would be necessary to control the amount of moisture exposed to the air-conditioning coil that supplies air to the locker room and shower areas.

Appendix A

City of Payette Electric and Gas Utility Rate Schedule

Appendix A

City of Payette Electric and Gas Utility Rate Schedule

Electric Rate Schedule -
Large General Service Rates for the Payette Area

1999
$5.54 Customer Charge
$0.36 BLC (Basic Load Capacity)
$2.73 / Kw (Demand Charge)
$0.024007 / Kwh (Electric Usage)

2000
$5.54 Customer Charge
$0.36 BLC (Basic Load Capacity)
$2.73 / Kw (Demand Charge)
$0.026858 / Kwh (Electric Usage)

2001
$5.54 Customer Charge
$0.36 BLC (Basic Load Capacity)
$2.73 / Kw (Demand Charge)
$0.043391 / Kwh (Electric Usage)

IDAHO PUBLIC UTILITIES COMMISS
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JUL 16 '01 JUL 16 '
Per. O.N. 28783
[signature] SECRETARY

Rate Schedule GS-1
GENERAL SERVICE

AVAILABILITY:

Available to individually metered customers whose requirements for natural gas do not exceed 2,000 therms per day, at any point on Company's distribution system. Requirements in excess of 2,000 therms per day may be served under this rate schedule upon execution of a one-year written service contract.

RATE:

Monthly minimum charge is the customer charge.

For billing periods ending April through November

Customer Charge - $2.00 per bill

Commodity Charge - First 200 therms per bill @ $0.83797*
Next 1,800 therms per bill @ $0.81624*
Over 2,000 therms per bill @ $0.79522*

For billing periods ending December through March

Customer Charge - $9.50 per bill

Commodity Charge - First 200 therms per bill @ $0.78712*
Next 1,800 therms per bill @ $0.76592*
Over 2,000 therms per bill @ $0.74546*

*Includes:

Temporary purchased gas cost adjustment of $0.16038
Weighted average cost of gas of $0.35295

I.P.U.C. Gas Tariff Second Revised Volume No. 1 (Supersedes First Revised Volume No. 1) Thirty-Third Revised Sheet	No. 03 (Page 1 of 2)
Name of Utility	Intermountain Gas Company

IDAHO PUBLIC UTILITIES COMMISSI
APPROVED EFFECTIVE

JAN 5 - '01 JAN 15 'C
Per. O.N. 28578
SECRETARY

Rate Schedule GS-1
GENERAL SERVICE

AVAILABILITY:

Available to individually metered customers whose requirements for natural gas do not exce 2,000 therms per day, at any point on Company's distribution system. Requirements in excess of 2,0 therms per day may be served under this rate schedule upon execution of a one-year written servi contract.

RATE:

Monthly minimum charge is the customer charge.

For billing periods ending April through November

Customer Charge - $2.00 per bill

Commodity Charge - First 200 therms per bill @ $0.81934*
Next 1,800 therms per bill @ $0.79761*
Over 2,000 therms per bill @ $0.77659*

For billing periods ending December through March

Customer Charge - $9.50 per bill

Commodity Charge - First 200 therms per bill @ $0.76849*
Next 1,800 therms per bill @ $0.74729*
Over 2,000 therms per bill @ $0.72683*

*Includes:

Temporary purchased gas cost adjustment of $0.06000
Weighted average cost of gas of $0.42296

Issued by: Intermountain Gas Company
By: Michael E. Huntington Title: Vice President – Marketing and External Affairs
Effective: January 15, 2001

IDAHO PUBLIC UTILITIES COMMISS
APPROVED EFFECTI
JUN 30 '00 JUL 1 - '0
Per. O.N. 28426
[signature] SECRET.

Rate Schedule GS-1
GENERAL SERVICE

AVAILABILITY:

Available to individually metered customers whose requirements for natural gas do not exceed 2,000 therms per day, at any point on Company's distribution system. Requirements in excess of 2,000 therms per day may be served under this rate schedule upon execution of a one-year written service contract.

RATE:

Monthly minimum charge is the customer charge.

For billing periods ending April through November

Customer Charge - $2.00 per bill

Commodity Charge - First 200 therms per bill @ $0.68311*
Next 1,800 therms per bill @ $0.66138*
Over 2,000 therms per bill @ $0.64036*

For billing periods ending December through March

Customer Charge - $9.50 per bill

Commodity Charge - First 200 therms per bill @ $0.63226*
Next 1,800 therms per bill @ $0.61106*
Over 2,000 therms per bill @ $0.59060*

*Includes:

Temporary purchased gas cost adjustment of $0.06000
Weighted average cost of gas of $0.28673

IPUC Gas Tariff	
Second Revised Volume No. 1	
(Supersedes First Revised Volume No. 1)	
Thirty-First Revised	Sheet No. 03 (Page 1 of 2)
Name of Utility	**Intermountain Gas Company**

IDAHO PUBLIC UTILITIES COMMISSIO
APPROVED EFFECTIVE
JUL 30 '99 AUG 1 - '99
Per. O.N. 28019
SECRETARY

Rate Schedule GS-1
GENERAL SERVICE

AVAILABILITY:

Available to individually metered customers whose requirements for natural gas do not exceed 2,000 therms per day, at any point on Company's distribution system. Requirements in excess of 2,000 therms per day may be served under this rate schedule upon execution of a one-year written service contract.

RATE:

Monthly minimum charge is the customer charge.

<u>For billing periods ending April through November</u>

Customer Charge - $2.00 per bill

Commodity Charge - First 200 therms per bill @ $0.53160*
Next 1,800 therms per bill @ $0.50987*
Over 2,000 therms per bill @ $0.48885*

<u>For billing periods ending December through March</u>

Customer Charge - $9.50 per bill

Commodity Charge - First 200 therms per bill @ $0.48075*
Next 1,800 therms per bill @ $0.45955*
Over 2,000 therms per bill @ $0.43909*

*Includes:

Temporary purchased gas cost adjustment of $0.01354
Weighted average cost of gas of $0.18252

Issued by **Intermountain Gas Company**

Appendix B

Utility Cost Breakdowns

Appendix B

Utility Cost Breakdowns

Utility Bill Data								
Date	**Gas**	**Therms**		**Date**	**Electricity**	**BLC**	**Demand**	**kWh**
8-6-01	$2,549.49	3125		7-2-01	$513.68	32	28	10620
6-18-01	$2,079.16	2537		6-4-01	$383.99	32	23	8820
5-21-01	$3,430.17	4226		5-7-01	$382.94	32	26	10980
5-7-01	$3,961.30	4890		4-2-01	$429.18	32	27	12600
3-19-01	$4,616.99	6092		3-5-01	$426.45	32	26	12600
2-20-01	$5,611.90	7710		2-5-01	$420.50	32	25	12480
2-5-01	$5,217.27	8484		1-16-01	$394.71	32	25	11520
12-18-00	$4,676.48	7595		12-4-00	$361.99	32	26	10200
11-20-00	$3,329.61	4944		11-6-00	$331.24	32	23	93600
11-6-00	$1,886.07	2784		10-2-00	$491.67	32	31	14520
10-2-00	$2,723.07	4053		9-5-00	$493.28	32	31	14580
8-31-00	$1,408.55	2060		8-7-00	$545.97	32	32	16440
8-7-00	$2,245.43	3926		7-5-00	$501.34	32	31	14880
7-5-00	$2,670.64	5205		6-5-00	$349.62		25	10920
6-5-00	$1,934.00	3742		5-1-00	$383.48		25	12420
5-1-00	$2,684.74	5233		4-17-00	$363.31		25	11580
4-3-00	$2,514.34	5435		3-6-00	$366.49		23	11940
2-22-00	$6,924.79	6456		2-7-00	$384.46		28	12120
1-3-00	$2,737.32	5928		1-18-00	$381.89		26	122404
12-6-99	$2,366.01	4600		12-6-99	$321.54		25	9840
11-1-99	$1,048.47	1984		11-1-99	$358.08		31	10680
10-4-99	$1,494.43	2869		10-4-99	$399.86		31	12420
9-7-99	$1,113.95	2222		9-7-99	$458.71		30	15000
8-2-99	$1,314.30	2726		8-2-99	$464.62		29	15360
7-6-99	$1,198.33	2476		7-6-99	$407.99		32	12660
6-7-99	$1,776.76	3723		6-7-99	$365.85		25	10500
5-3-99	$2,809.28	5949		5-3-99	$388.58		27	10860
4-5-99	$2,564.90	6080		4-5-99	$435.56		26	12660
3-1-99	$2,714.67	6443		3-15-99	$440.96		28	12660
2-1-99	$3,724.29	8890		2-17-99	$414.46		28	11700
1-4-99	$2,764.59	6564		1-18-99	$463.10		27	13560

Electricity Data										
DATE	**# Days in Billing Cycle**	**$ Per Day**	**BLC**	**Demand kW**	**kWh**	**Customer Charge**	**Consumption kWh**	**Demand Cost**	**BLC Cost**	**Total Cost**
7/2/2001	28	$18.35	32	28	10620	$5.54	$420.18	$76.44	$11.52	$513.68
6/4/2001	27	$14.22	32	23	8820	$5.54	$236.89	$62.79	$11.52	$316.74
5/7/2001	35	$10.94	32	26	10980	$5.54	$294.90	$70.98	$11.52	$382.94
4/2/2001	27	$15.90	32	27	12600	$5.54	$338.41	$73.71	$11.52	$429.18
3/5/2001	30	$14.22	32	26	12600	$5.54	$338.41	$70.98	$11.52	$426.45
2/5/2001	19	$22.13	32	25	12480	$5.54	$335.19	$68.25	$11.52	$420.50
1/16/2001	42	$9.40	32	25	11520	$5.54	$309.40	$68.25	$11.52	$394.71
12/4/2000	28	$12.93	32	26	10200	$5.54	$273.95	$70.98	$11.52	$361.99
11/6/2000	34	$9.74	32	23	9360	$5.54	$251.39	$62.79	$11.52	$331.24
10/2/2000	27	$18.21	32	31	14520	$5.54	$389.98	$84.63	$11.52	$491.67
9/5/2000	28	$17.62	32	31	14580	$5.54	$391.59	$84.63	$11.52	$493.28
8/7/2000	32	$17.06	32	32	16440	$5.54	$441.55	$87.36	$11.52	$545.97
7/5/2000	30	$16.71	32	31	14880	$5.54	$399.65	$84.63	$11.52	$501.34
6/5/2000	34	$10.28		25	10920	$5.54	$432.05	$68.25	$0.00	$505.84
5/1/2000	14	$27.39		25	12420	$5.54	$491.40	$68.25	$0.00	$565.19
4/17/2000	41	$8.86		25	11580	$5.54	$458.16	$68.25	$0.00	$531.95
3/6/2000	29	$12.64		23	11940	$5.54	$472.41	$62.79	$0.00	$540.74
2/7/2000	19	$20.23		28	12120	$5.54	$479.53	$76.44	$0.00	$561.51
1/18/2000	42	$9.09		26	12404	$5.54	$490.76	$70.98	$0.00	$567.28
12/6/1999	35	$9.19		25	9840	$5.54	$389.32	$68.25	$0.00	$463.11
11/1/1999	27	$13.26		31	10680	$5.54	$422.55	$84.63	$0.00	$512.72
10/4/1999	27	$14.81		31	12420	$5.54	$491.40	$84.63	$0.00	$581.57
9/7/1999	35	$13.11		30	15000	$5.54	$593.48	$81.90	$0.00	$680.92
8/2/1999	26	$17.87		29	15360	$5.54	$607.72	$79.17	$0.00	$692.43
7/6/1999	29	$14.07		32	12660	$5.54	$500.89	$87.36	$0.00	$593.79
6/7/1999	34	$10.76		25	10500	$5.54	$415.43	$68.25	$0.00	$489.22
5/3/1999	28	$13.88		27	10860	$5.54	$429.68	$73.71	$0.00	$508.93
4/5/1999	20	$21.78		26	12660	$5.54	$500.89	$70.98	$0.00	$577.41
3/15/1999	28	$15.75		28	12660	$5.54	$500.89	$76.44	$0.00	$582.87
2/17/1999	29	$14.29		28	11700	$5.54	$462.91	$76.44	$0.00	$544.89
1/18/1999				27	13560	$5.54	$536.50	$73.71	$0.00	$615.75

Natural Gas Data				
DATE	# Days in Billing Cycle	Fuel Cost	$/day	Therms
8/6/01	48	$2,549.49	$53.11	3125
6/18/01	27	$2,079.16	$77.01	2537
5/21/01	14	$3,430.17	$245.01	4226
5/7/01	48	$3,961.30	$82.53	4890
3/19/01	29	$4,616.99	$159.21	6092
2/20/01	15	$5,611.90	$374.13	7710
2/5/01	47	$5,217.27	$111.01	8484
12/18/00	28	$4,676.48	$167.02	7595
11/20/00	14	$3,329.61	$237.83	4944
11/6/00	34	$1,886.07	$55.47	2784
10/2/00	32	$2,723.07	$85.10	4053
8/31/00	24	$1,408.55	$58.69	2060
8/7/00	32	$2,245.43	$70.17	3926
7/5/00	30	$2,670.64	$89.02	5205
6/5/00	34	$1,934.00	$56.88	3742
5/1/00	28	$2,684.74	$95.88	5233
4/3/00	41	$2,514.34	$61.33	5435
2/22/00	49	$6,924.79	$141.32	6456
1/3/00	27	$2,737.32	$101.38	5928
12/6/99	35	$2,366.01	$67.60	4600
11/1/99	27	$1,048.47	$38.83	1984
10/4/99	27	$1,494.43	$55.35	2869
9/7/99	35	$1,113.95	$31.83	2222
8/2/99	26	$1,314.30	$50.55	2726
7/6/99	29	$1,198.33	$41.32	2476
6/7/99	34	$1,776.76	$52.26	3723
5/3/99	28	$2,809.28	$100.33	5949
4/5/99	34	$2,564.90	$75.44	6080
3/1/99	30	$2,714.67	$90.49	6443
2/1/99	27	$3,724.29	$137.94	8890
1/4/99		$2,764.59		6564

Appendix C

Energy Smart Pools Software Information

Appendix C

Energy Smart Pools Software Information

The Energy Smart Pools software estimates the annual cost of heating both indoor and outdoor in-ground swimming pools and spas. It analyzes energy and water savings from using pool covers and solar pool-heating systems. In addition, it can determine differences between conventional heating and high-efficiency heating systems and conventional and high-efficiency electric motors. For more information, visit the Energy Efficiency and Renewable Energy website at http://www.eren.doe.gov/.

Appendix D

Facility Energy Decision System Software Information

Appendix D

Facility Energy Decision System Software Information

Facility Energy Decision System, or FEDS, is a software tool developed with Federal funds that can quickly and objectively identify energy improvements that maximize savings. With limited user input, this program:

??develops a building prototype and engineering parameters

??calculates electrical demand and energy consumption

??determines potential retrofits and their cost effectiveness

??provides detailed analysis of single buildings or large installations with many buildings.

FEDS has the following capabilities:

??Can analyze one building or hundreds of buildings.

??Life cycle cost optimization—selects the minimum life cycle cost retrofit for a single building or an entire campus of buildings.

??Technology and fuel independence—chooses the technology that provides the required service at the minimum life cycle cost.

??Peak tracking—determines the hourly contribution of each technology to the installation's peak demand, allows accurate determination of the value of the energy and demand savings associated with a retrofit, and considers interactive effects between buildings and between building systems.

??Alternative financing analyzes various types of financing mechanisms.

Appendix E

Life Cycle Cost Examples

Appendix E

Life Cycle Cost Examples

Note: Example only and not specific to Payette

ENERGY LIFE CYCLE COST ANALYSIS SPREADSHEET	"ELCCA3.XLS"	37201.49283
		0.492834375

------------ P R O J E C T   D A T A---

PROJECT: City of Payette	Battelle
ALT. No.: Over-the-Purlin (R-11)	Rita

----------- D I S C O U N T   &   E S C A L A T I O N Real Rates per WSEO Jan 1995---

Q & A:	1 = Yes		Years:	Rate:
	0 = No	Real Discount Rate (i)	1,993 - 2,020	0.029
		Electricity.	1,993 - 2,000	0.001
IOU Electric	1	(Investor Owned Utility)	2,001 - 2,020	0.007
POU Electric(PUD)**	0	Natural Gas	1,993 - 2,000	0.008
Natural Gas Fuel?	1		2,001 - 2,010	0.01
Propane Fuel?	0		2,011 - 2,020 . . .	0.009
Oil Fuel?	0	Maintenance	1,993 - 2,020	0.005
Coal Fuel?	0	Replacement	1,993 - 2,020	0
Wood/Renewable	0	Inflation (Nominal , not used)	1,993 - 2,020	0.03

253732.7115=25-year LCC

--------- A N N U A L   R E A L   C A S H   F L O W S---

(Begin) Year	First & Replace. Costs	Annual Maint. Costs	Annual Nat.Gas Costs	Annual Electric Costs	Total Annual Costs	Present Worth Factor	Present Worth of Annual Costs	Present Worth of Cumulative Costs
2001	17442	34.884	9209	2835	12078.88	(1+i)^-n		
2001	17442	--	--	--	17442	1	17442	17442
2002	0	35.05842	9301.09	2854.845	12190.99	0.971817298	11847.41829	29289.41829
2003	0	35.23371	9394.101	2874.829	12304.16	0.944428861	11620.40715	40909.82544
2004	0	35.40988	9488.042	2894.953	12418.4	0.917812305	11397.76446	52307.5899
2005	0	35.58693	9582.922	2915.217	12533.73	0.891945874	11179.40577	63486.99567
2006	0	35.76486	9678.752	2935.624	12650.14	0.86680843	10965.24827	74452.24394
2007	0	35.94369	9775.539	2956.173	12767.66	0.842379426	10755.21076	85207.4547
2008	0	36.12341	9873.294	2976.866	12886.28	0.818638898	10549.21363	95756.66833
2009	0	36.30402	9972.027	2997.705	13006.04	0.795567442	10347.17878	106103.8471
2010	0	36.48554	10071.75	3018.688	13126.92	0.773146203	10149.02967	116252.8768
2011	0	36.66797	10162.39	3039.819	13238.88	0.751356854	9947.123738	126200.0005
2012	0	36.85131	10253.85	3061.098	13351.8	0.730181588	9749.241662	135949.2422
2013	0	37.03557	10346.14	3082.526	13465.7	0.709603098	9555.3031	145504.5453
2014	0	37.22075	10439.25	3104.103	13580.58	0.689604566	9365.229316	154869.7746

2015	0	37.40685	10533.21	3125.832	13696.45	0.670169646	9178.94315	164048.7177
2016	0	37.59388	10628.01	3147.713	13813.31	0.651282455	8996.368987	173045.0867
2017	0	37.78185	10723.66	3169.747	13931.19	0.632927556	8817.432721	181862.5195
2018	0	37.97076	10820.17	3191.935	14050.08	0.615089947	8642.061732	190504.5812
2019	0	38.16062	10917.55	3214.279	14169.99	0.597755051	8470.184851	198974.766
2020	0	38.35142	11015.81	3236.779	14290.94	0.580908698	8301.732332	207276.4984
2021	0	38.54318	11114.95	3259.436	14412.93	0.564537122	8136.635823	215413.1342
2022	0	38.73589	11214.99	3282.252	14535.98	0.548626941	7974.828342	223387.9625
2023	0	38.92957	11315.92	3305.228	14660.08	0.533165151	7816.244244	231204.2068
2024	0	39.12422	11417.77	3328.365	14785.26	0.518139117	7660.819197	238865.026
2025	0	39.31984	11520.53	3351.663	14911.51	0.503536557	7508.490157	246373.5161
2026	0	39.51644	11624.21	3375.125	15038.85	0.489345536	7359.195338	253732.7115
Totals:	17442	931.1206	261185.9	77700.8	357259.9		253732.7115=25-year LCC	
	1st+Repl	Maint	Fuel	Elec				

Instructions:

1. C11..C18 Plug in 1 if true, 0 if false

C12 : If electric utility is privately owned enter 1
C13 : If electric utility is Publicly owned (a PUD) enter 1
C14 : If Natural Gas escalation factors are desired enter 1
C15 : If propane/LPG escalation factors are desired enter 1
C16 : If Oil escalation factors are desired enter 1
C17 : If coal escalation factors are desired enter 1
C18 : If wood fuel or renewable escalation factors are desired enter 1
note: this includes wood pellets, hog and waste

2. A26: Enter First analysis year

3. B26: Estimated construction cost would be differential cost of the subject system, e.g. a lighting system (With Overhead & Profit, Tax, Design Fees, etc.). If this was the least cost baseline system, this would be zero.

4. C26: "Annual Maint Cost" includes boiler water and cooling tower water treatment, air filter changes, lubrication, boiler tune up, condenser cleaning, controls calibration, and other routine maintenance. This is calculated at approximately 2% of initial cover cost and adjusted over time for inflation.

5. D26: "Annual Gas Costs" (or other heating utility). Current utility rate structure is applied to monthly consumption from the building computer model. First year dollar total is in this cell.

6. E26: "Annual Electric Costs" Baseline numbers are used for Annual Electric Cost so that savings are measured in Natural Gas. Enter first year dollar total in this cell.

7. B28…B52: Replacement Costs include planned maintenance such as heat pump compressor replacements, cooling tower and chiller replacements, boiler and burner replacements, boiler and condenser retubing, and other major refurbishing.

The spreadsheet example replacement costs include:
B34: Cover replacement in the 7th year
B40: Cover replacement in the 14th year.
B47: cover replacement in the 21st year.

Print range is A1..J55

Definitions:
Present Worth Factor is 1/((i+1)^n)
where n is the period in years
and i is the discount rate

Projections based on current Northwest Power Planning Council data.

Real: Over and above general inflation.
Nominal: Including general inflation.
General Inflation: Assumed to be 4% from 1,993 through 2,020.

To convert between real and nominal escalation or discount rates:

Nominal = Real + Discount + (Real * Discount)

ENERGY LIFE CYCLE COST ANALYSIS SPREADSHEET "ELCCA3.XLS" 37201.49

0.493161

------------ P R O J E C T D A T A---

PROJECT: City of Payette Battelle

ALT. No.: All Pools Vinyl Rita

----------- D I S C O U N T & E S C A L A T I O N Real Rates per WSEO Jan 1995--

			Years:	Rate:
Q & A:	1 = Yes			
	0 = No	Real Discount Rate (i)	1,993 - 2,020	0.029
		Electricity.	1,993 - 2,000	0.001
IOU Electric	1	(Investor Owned Utility)	2,001 - 2,020	0.007
POU Electric(PUD)**	0	Natural Gas	1,993 - 2,000	0.008
Natural Gas Fuel?	1		2,001 - 2,010	0.01
Propane Fuel?	0		2,011 - 2,020 . . .	0.009
Oil Fuel?	0	Maintenance	1,993 - 2,020	0.005
Coal Fuel?	0	Replacement	1,993 - 2,020	0
		Inflation (Nominal , not used)		
Wood/Renewable	0	.	1,993 - 2,020	0.03

418057.4=25-year LCC

--------- A N N U A L R E A L C A S H F L O W S---

(Begin) Year	First & Replace. Costs	Annual Maint. Costs	Annual Nat.Gas Costs	Annual Electric Costs	Total Annual Costs	Present Worth Factor	Present Worth of Annual Costs	Present Worth of Cumulative Costs
2001	6851	13.702	17397	2835	20245.7	(1+i)^-n	Costs	Costs
2001	6851	--	--	--	6851	1	6851	6851
2002	0	13.77051	17570.97	2854.845	20439.59	0.971817	19863.54	26714.54
2003	0	13.83936	17746.68	2874.829	20635.35	0.944429	19488.62	46203.16
2004	0	13.90856	17924.15	2894.953	20833.01	0.917812	19120.79	65323.95
2005	0	13.9781	18103.39	2915.217	21032.58	0.891946	18759.93	84083.88
2006	0	14.04799	18284.42	2935.624	21234.09	0.866808	18405.89	102489.8
2007	0	14.11823	18467.27	2956.173	21437.56	0.842379	18058.56	120548.3
2008	6851	14.18882	18651.94	2976.866	28493.99	0.818639	23326.29	143874.6
2009	0	14.25977	18838.46	2997.705	21850.42	0.795567	17383.48	161258.1
2010	0	14.33107	19026.84	3018.688	22059.86	0.773146	17055.5	178313.6
2011	0	14.40272	19198.08	3039.819	22252.31	0.751357	16719.42	195033
2012	0	14.47474	19370.87	3061.098	22446.44	0.730182	16389.98	211423
2013	0	14.54711	19545.2	3082.526	22642.28	0.709603	16067.03	227490
2014	0	14.61984	19721.11	3104.103	22839.83	0.689605	15750.45	243240.5
2015	6851	14.69294	19898.6	3125.832	29890.13	0.67017	20031.46	263271.9
2016	0	14.76641	20077.69	3147.713	23240.17	0.651282	15135.91	278407.9
2017	0	14.84024	20258.39	3169.747	23442.98	0.632928	14837.71	293245.6
2018	0	14.91444	20440.71	3191.935	23647.56	0.61509	14545.38	307790.9
2019	0	14.98901	20624.68	3214.279	23853.95	0.597755	14258.82	322049.8

2020	0	15.06396	20810.3	3236.779	24062.14	0.580909	13977.91	336027.7
2021	0	15.13928	20997.6	3259.436	24272.17	0.564537	13702.54	349730.2
2022	6851	15.21498	21186.57	3282.252	31335.04	0.548627	17191.25	366921.5
2023	0	15.29105	21377.25	3305.228	24697.77	0.533165	13167.99	380089.4
2024	0	15.36751	21569.65	3328.365	24913.38	0.518139	12908.6	392998
2025	0	15.44434	21763.77	3351.663	25130.88	0.503537	12654.32	405652.4
2026	0	15.52156	21959.65	3375.125	25350.29	0.489346	12405.05	418057.4
Totals:	27404	365.7326	493414.2	77700.8	598884.8		418057.4=25-year LCC	
	1st+Repl	Maint	Fuel	Elec				

F U E L   P R I C E   E S C A L A T I O N   I N F O R M A T I O N:
July 1993 projections.

Select value and key in above as decimal fraction.

	Years:		
Electricity	1,995 - 2,000 . . .	0.001	0.001
(Investor-Owned)	2,001 - 2,020 . . .	0.007	0.007
Electricity	1,995 - 2,000 . . .	0.001	0.001
(Public Owned)	2,001 - 2,020 . . .	0.003	0.003
Natural Gas	1,995 - 2,000 . . .	0.008	0.008
	2,001 - 2,010 . . .	0.01	0.01
	2,011 - 2,020 . . .	0.009	0.009
#2 Distillate Oil	1,995 - 2,000 . . .	0.01	0.01
	2,001 - 2,010 . . .	0.013	0.013
	2,011 - 2,020 . . .	0.017	0.017
Residual Oil	1,993 - 2,000 . . .	Assume same as distillate oil,	
	2,001 - 2,020 . . .		
Propane	1,993 - 2,000 . . .	Assume same as natural gas,	
	2,001 - 2,020 . . .		
Wood Pellets	1,993 - 2,000 . . .	0	0
	2,001 - 2,020 . . .	0	0

Instructions:

1. C11..C18 Plug in 1 if true, 0 if false
C12 : If electric utility is privately owned enter 1
C13 : If electric utility is Publicly owned (a PUD) enter 1
C14 : If Natural Gas escalation factors are desired enter 1
C15 : If propane/LPG escalation factors are desired enter 1
C16 : If Oil escalation factors are desired enter 1
C17 : If coal escalation factors are desired enter 1
C18 : If wood fuel or renewable escalation factors are desired enter 1
note: this includes wood pellets, hog and waste

2. A26: Enter First analysis year

3. B26: Estimated construction cost would be differential cost of the subject system, e.g. a lighting system (With Overhead & Profit, Tax, Design Fees, etc.). If this was the least cost baseline system, this would be zero.

4. C26: "Annual Maint Cost" includes boiler water and cooling tower water treatment, air filter changes, lubrication, boiler tune up, condenser cleaning, controls calibration, and other routine maintenance. This is calculated at approximately 2% of initial cover cost and adjusted over time for inflation.

5. D26: "Annual Gas Costs" (or other heating utility). Current utility rate structure is applied to monthly consumption from the building computer model. First year dollar total is in this cell.

6. E26: "Annual Electric Costs". Baseline numbers are used for Annual Electric Cost so that savings are measured in Natural Gas. Enter first year dollar total in this cell.

7. B28..B52: Replacement Costs include planned maintenance such as heat pump compressor replacements, cooling tower and chiller replacements, boiler and burner replacements, boiler and condenser retubing, and other major refurbishing.

The spreadsheet example replacement costs include:
B34: Cover replacement in the 7th year
B40: Cover replacement in the 14th year.
B47: cover replacement in the 21st year.

Print range is A1..J55
Definitions:
Present Worth Factor is 1/((i+1)^n)
where n is the period in years
and i is the discount rate

Projections based on current Northwest Power Planning Council data.

Real: Over and above general inflation.
Nominal: Including general inflation.
General Inflation: Assumed to be 4% from 1,993 through 2,020.
To convert between real and nominal escalation or discount rates:

Nominal = Real + Discount + (Real * Discount)

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