Energy Life-Cycle Cost Analysis

Guidelines for Public Agencies in Washington State

November 2005
Revised April, 2013 to change GA to DES

Washington State Department of Enterprise Services
Engineering & Architectural Services

http://www.des.wa.gov/services/facilities/energy/elcca

Foreword

Public agencies are responsible for ensuring that energy conservation and renewable energy systems are considered in the design phase of major facilities by completing an energy life-cycle cost analysis (ELCCA) as described in Revised Code of Washington (RCW) 39.35.

The Washington State Department of Enterprise Services (DES) is identified in RCW 39.35.050 as having responsibility to develop life-cycle cost analysis guidelines as tools for agencies to use to promote the selection of low life-cycle cost alternatives. Elements of the U.S. Green Building Council's Leadership in Energy and Environment Design (LEED ® NC) criteria have been included. LEED is a registered trademark of the U.S. Building Green Council.

DES Contacts

For questions or assistance in preparing an ELCCA, contact:

Washington State Department of Enterprise Services
Division of Engineering and Architectural Services
ELCCA Lead Reviewer
1500 Jefferson Street Building
Second Floor, P.O. Box 41476
Olympia, Washington 98504-1476

E-mail: ELCCA@des.wa.gov
Voice: (360) 407-9375 or 407-9380

The life-cycle cost analysis spreadsheet forms can be obtained online at
http://www.des.wa.gov/services/facilities/energy/elcca

Printed on Recycled Paper

This booklet can be made available on another format for people with disabilities. Please call (206) 255-7216. TTY users please use relay service. Disability access information can be obtained at
http://www.des.wa.gov/services/facilities/Construction/ForAgencies/Pages/BarrierFreeFacilities.aspx

Table of Contents

Chapter 7
ELCCA Addendum

Figures/Forms

Tables

Chapter 1

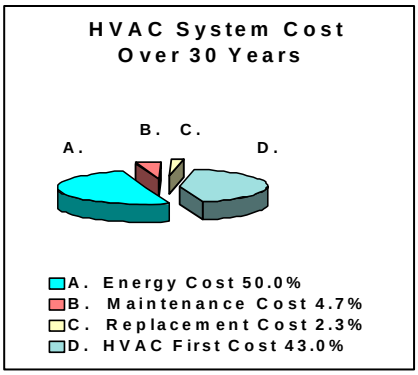
Introduction

Since 1975, the State of Washington has required that an Energy Life-Cycle Cost Analysis (ELCCA) be performed during the design of all publicly owned or leased facilities. The intent is to help build cost-effective, efficient public facilities.

The ELCCA encourages energy efficiency by evaluating the total cost of ownership of several competing design alternatives. The Washington State Department of Enterprise Services (DES) supports this goal by publishing these guidelines, identifying and encouraging the consideration of cost-effective building technologies, and providing assistance in the development and review of ELCCA reports.

Energy Life Cycle Cost Analysis

Figure 1.1 HVAC Cost Pie Illustration



The ELCCA is a decision-making tool that compares the owning and operating costs for energy using systems: heating, cooling, lighting, building envelope, and domestic hot water. The analysis accounts for the initial cost of construction or renovating a facility, as well as the cost of owning and operating a facility over its useful life. These costs make up the total cost of ownership for a building.

The ELCCA provides a method for the owner to evaluate different energy using system options and to select the most cost-effective ones. The completed ELCCA report recommends the alternatives that make the most economic sense while providing for the comfort, health, and the productivity of the building occupants.

Legislation

In 1975, the Washington State Legislature enacted “Energy Conservation in Design of Public Facilities” to ensure that energy conservation practices are incorporated into the design of energy using systems of major public facilities, both new construction and extensive renovations. The law applies to state agencies, including colleges and universities, and political subdivisions such as cities, counties, school districts, and other special taxing districts. Requirements pertaining to ELCCA are based on the Revised Code of Washington (RCW) 39.35 and the Washington Administrative Code (WAC) 180-27-075; relevant sections are provided in Appendix B.

In 2001, the Legislature added language requiring that ELCCAs analyze a system “which shall comply at a minimum with the sustainable design guidelines of the U.S. Green Building Council’s LEED NC Silver Standard or similar design standard as may be adopted by rule by the department RCW 39.35.030(11)(a.). Of a total of 69 possible points on the LEED NC Checklist, 33 to 38 are required for a Silver rating. The LEED NC Checklist is included in Chapter 3.

In these guidelines, GA adopts use of the LEED Silver rating by requiring analysis of what will be known as a "High Performance" alternative. To meet the legislative intent for energy efficiency and renewable, GA further requires that the "High Performance" alternative earn a minimum of four of the required points from the LEED "Energy & Atmosphere Credit 1: Optimize Energy Performance." GA also requires analysis of a "Renewable Alternative." Check the ELCCA web http://www.des.wa.gov/services/facilities/energy/elcca for spreadsheets, updates, forms and contacts useful to the preparation of ELCCA documents.

Purpose of the ELCCA Guidelines and the Process

These guidelines define the procedures and methods for performing ELCCAs, promote the selection of low life-cycle cost alternatives, provide standard reporting formats, and provide valuable insights about energy efficient design elements that should be incorporated early in the design process.

Other objectives of the guidelines are:

- Identify the timeline for phases of the ELCCA in the design process
- Provide standardized economic assumptions to be used for equipment service life, building life, maintenance costs, and fuel escalation and inflation rates
- Encourage ELCCA Analysts to use renewable resources when feasible and cost-effective

Review and Approval of ELCCAs

GA will review ELCCAs for any public entity produced to satisfy RCW 39.35. A fee will be charged for this review pursuant to RCW 39.35.060. The review of the ELCCA brings an additional experienced energy engineer into the design process to review the submittals. Public entities wishing to make other arrangements for review of their ELCCAs may do so. A review checklist is included in Appendix C and should be used to check format and content for the ELCCA submittals.

GA has been designated by the Office of the Superintendent of Public Instruction (OSPI) to review all public school projects receiving state construction funds. Only school projects receiving state funding are required to be reviewed by GA. Note: OSPI refers to ELCCAs of public schools as Energy Conservation Reports (ECRs).

How Have These Guidelines Changed?

Following are changes from the previous version of these guidelines (June 1998):

- A new “Green Building Options” submittal is added. This consists of an Environmental Design Considerations (EDC) form and a LEED NC Checklist to be completed by the project architect and building owner early in schematic design.
- A “High Performance” alternative is added.
- A “Code Baseline” is added.
- Economic factors to be used in the analysis are updated.
- Forms and appendices are updated.
- The prescriptive approach for mechanical systems is eliminated.
- The prescriptive requirements for lighting and envelope systems are revised.
- The basis for prototypical reports is clarified.
- Design submittals can only be based on the current version of the ELCCA Guidelines.
- The “Verification Checklist” is eliminated.
- The “ELCCA Submittal Evaluation” is eliminated.
- Energy efficient references and contacts, including free technical assistance, are added. Check the ELCCA website at http://www.des.wa.gov/services/facilities/energy/elcca for additional links.

Chapter 2

The ELCCA Process

This chapter defines the projects requiring an ELCCA and identifies the participants and submittals required in preparing the ELCCA.

Projects Requiring an ELCCA

An ELCCA is required in the design of all major publicly owned or leased facilities, i.e. when public funds are used to build and/or operate the new or renovated facility. Projects that require an ELCCA:

1. **New Major Facilities,** having 25,000 square feet or more of usable floor space.
2. **Building Renovations/Modernizations,** additions, alterations, or repairs of an existing major facility (25,000 square feet or more) completed within any 12-month period where the project cost is over 50 percent of the replacement value of the facility and the project affects energy-using system(s).

   Example: An agency plans to remodel a 25,000 square foot building for $80 per square foot. The building replacement value is $150 per square foot. The project cost (25,000 x $80 = $2,000,000) divided by the building replacement value (25,000 x $150 = $3,750,000) is equal to 0.53, which is greater than 0.50. Therefore, the project requires an ELCCA.
3. **Combinations (or multiples) of new and renovated facilities** that will be built on the same site during any 12-month period, if the sum of the affected areas is equal to or greater than 25,000 square feet.

   Example: An agency plans to remodel a 15,000 square foot building and add 20,000 square feet in two phases with separate contracts. The addition is to be completed in October and the remodel will be bid the following May. This is considered a single project, and an ELCCA is required because the area is greater than 25,000 square feet (15,000 + 20,000) and the phases will occur within a 12-month period (October to May).

4. **Prototypic Buildings:** Identical buildings built on the same or different sites during any 48-month period shall have a full ELCCA performed for the initial or prototypic building, but subsequent buildings may only need to have an abbreviated report. This applies to buildings less than 100,000 square feet in area. The prototype building must meet current guidelines, and the Reviewer and Analyst must agree that a full analysis will not benefit the project.

Additional Requirements for Public School Projects

For K-12 projects receiving funding from OSPI, the following project categories do not require an ELCCA but do require that a "Public Facility Energy Characteristics" (PFEC) form (see Chapter 5) and a cover letter be submitted to the Reviewer during the design development phase:

- New construction between 5,000 and 25,000 square feet
- Remodels between 5,000 and 25,000 square feet
- Remodels over 25,000 but not meeting the 50% rule above

Participants, Responsibilities, and Qualifications

Figure 2.1 outlines the responsibilities of each ELCCA participant (by project phase and ELCCA submittal). For example:

- The Owner (building owner or owner's representative) will review all the ELCCA deliverables with the design team.

- The A/E Team (referred to hereafter as "architect") is responsible for the design schedule and will submit both the LEED™ Checklist and the Environmental Design Considerations (EDC) during the schematic design phase. These will be considered along with the Work Plan.

- The ELCCA Analyst (the "Analyst") is responsible for preparing the Work Plan, the ELCCA Report, and the Addendum and submitting them to the ELCCA Reviewer. The Analyst must either be, or work under the responsible charge of an architect or engineer licensed in the State of Washington. The analyst should have public building design experience and be familiar with energy modeling techniques. Reports shall be signed and stamped by the Analyst or person in responsible charge. The architect shall sign the cover page as having examined the report.

- The ELCCA Reviewer (the "Reviewer") performs a thorough review of each submittal and provides a written response in a timely manner. The Reviewer ensures that the ELCCA meets all requirements as defined in the RCW 39.35 and these guidelines.

- Utilities that serve the facility are good resources for the design team. Coordinating the ELCCA process with utilities may identify opportunities for additional efficiency measures, as well as financial incentives and technical assistance the utility can provide to the project. Contact information for electric and gas utilities is listed in Appendix D.

ELCCA Process/Submittals

A flowchart of the ELCCA process is provided as Figure 2.2. The ELCCA process contains four separate submittals:

1. Green Building Options
2. Work Plan
3. ELCCA Report
4. Addendum

The schedule for submittals is shown in Figure 2.1 and indicated below.

1. Green Building Options (See Chapter 3)

Schedule: Developed jointly by the project architect and the owner's representative and submitted to the ELCCA Reviewer early in schematic design, prior to development of the Work Plan.

The "Green Building Options" submittal consists of two separate forms intended to assist in development of the High Performance Alternative to be studied in the ELCCA.

- The **LEED™ Checklist** presents the full range of the U.S. Green Building Council's scoring system used for LEED certification.
- The **Environmental Design Considerations** (EDC) form lists specific design elements that should be considered for sustainable design. Many of these elements have an impact on the efficient use of energy. The intent is that this will assist in developing the High Performance Alternative.

Work Plan (See Chapter 4)

Schedule: Developed and submitted by the ELCCA Analyst (to the ELCCA Reviewer) during schematic design. The Reviewer may suggest additional or alternative options to be analyzed. Once the Reviewer approves the Work Plan, the Analyst may begin the ELCCA.

The Work Plan is an outline of what the Analyst intends to accomplish with the ELCCA report. The Work Plan includes a description of the building and participants, and reflects the planned analysis for each energy system to be addressed in the ELCCA (including building envelope, lighting, domestic hot water, mechanical systems, renewable energy systems, and other energy systems). It identifies the envelope and lighting prescriptives to be employed and the specific renewables and High Performance Alternative to be considered.

3. **The ELCCA Report** (See Chapters 5 and 6)

Schedule: Prepared by the Analyst and submitted to the Reviewer during design development.

The ELCCA Analyst must submit a report consistent with the analysis guidelines (described in Chapter 5) and the report guidelines (described in chapter 6). Figure 2.2 illustrates the general approach.

Alternatives undergo computer simulation to arrive at energy costs. First cost, replacement costs, and maintenance costs are calculated, usually by spreadsheet. The ELCCA analysis is done in a particular order termed a "rolling baseline". This generally involves the development of the building envelope components first, then lighting systems, and ends with the study of HVAC alternatives and renewable energy systems. Lastly, the High Performance Alternative is developed using a cost-savings goal sufficient to earn four LEED points from the "Energy & Atmosphere: Optimize Energy Performance" credit.

Note: A project undergoing ELCCA need not always choose the lowest life-cycle cost alternative. The requirement is that total life-cycle costs *be considered* in the design of publicly owned facilities. If the selected or recommended design varies from the lowest life-cycle cost, a letter is required from the owner noting that the owner has been made aware of this situation and describing the reasons for the choice.

4. **ELCCA Addendum** (See Chapter 7)

Schedule: Submitted by the Analyst to the Reviewer early in the construction document phase (a minimum of five weeks before construction documents are released for bid).

The Addendum will address comments and identify any changes suggested by the Value Engineering (VE) team or identified during the design process (that have been accepted by the owner). The Addendum must contain revised sections for the ELCCA report (if there have been changes in design that affect energy systems) and an updated PFEC form.

The ELCCA Reviewer will examine the Addendum and any revised materials on energy use simulation and economic analysis. Following this review, a recommendation for approval will be provided to the building owner. The approval signifies that the ELCCA is completed in accordance with the guidelines.

Figure 2.1 ELCCA Integration with Building Design Phases

	A/E Selec-tion	Schematic Design			Design Development			VE Review		Construction Documents	
Owner	Select A/E and VE Team	Determine whether ELCCA is require	Participate in Green Building Options development	Participate in Work Plan development		Review ELCCA Report			Select ELCCA & VE team Suggestion	Verify implementation Letter of justification if lowest Life Cycle Alternative is not implemented	
A/E Team		Determine whether ELCCA is require	Participate in development and submit forms for Green Building options	Participate in Work Plan development		Review ELCCA Report		Present design to VE team		Verify to owner that ELCCA decisions will be incorporated in design	
										Incorporate owner's decisions	
ELCCA Analyst				**Prepare ELCCA Work Plan**	Prepare ELCCA Report	**Submit ELCCA to Owner & Reviewer**	**Address comments & make corrections to report**	**Present ELCCA to VE team**		**Prepare & submit Addendum reflecting owner's decisions**	
ELCCA Reviewer			Receive Green Bldg. options	Review & approve Work Plan			Review Report & return comments			Review Addendum	Recommend ELCCA to owner
VE Team								Consider Life Cycle Costs in VE report			
Utilities				Participate in Work Plan development to assist with							

Note: Items in bold denote Submittals to ELCCA Reviewer

Chapter 3

Green Building Options

This chapter explains the first ELCCA submittals (the Green Building Options), which consist of the Environmental Design Considerations (EDC) form and the LEED -NC Checklist (or an acceptable approved alternative). The purpose of these forms is to assist in developing the High Performance Alternative.

The owner's representative and the architect, at a minimum, should collaborate on completing these forms.

These forms are completed and submitted to the ELCCA Reviewer early in the schematic design phase of the project, and will assist in development of the Work Plan.

Green Building Options Preparation

The architect or owner's representative shall complete the EDC form and LEED -NC Checklist to reflect a LEED -NC Silver rating, with a minimum of four points in the "Optimize Energy Performance" category of the LEED -NC Checklist. Energy-related elements of the LEED -NC Checklist should be reflected in the High Performance Alternative in the Work Plan, as a potential means of achieving the goal of 30% energy cost savings for new construction, and 20% energy cost savings for major remodels. These energy savings would be sufficient for four points under "Optimize Energy Performance" but may involve other LEED points in categories such as "Renewable Energy," "Carbon Dioxide Monitoring," "Controllability of Systems," "Daylighting & Views," and others.

The EDC is a list of green building elements that could be considered (see Figure 3.1). The LEED -NC Checklist reflecting a LEED -NC Silver rating is completed in good faith to reflect what would be "possible" for the proposed building. (See example in Figure 3.2. Note that the Analyst should use the most current version from the U.S. Green Building Council, http://www.usgbc.org/LEED

> Example: If no bus service is available within ¼ mile of the site and will not be available anytime soon, then select "no" for LEED Sustainable Sites Credit 4.1. (Alternative Transportation)

The following general approach adapted from a 2004 GSA report on *LEED study by Steve Winter Associates Inc.*, can help designers with the task of proposing a cost-effective green building:

- Claim LEED credits for all measures required by local environmental agencies and building codes
- Claim LEED credits that can be obtained for little or no cost resulting from site conditions or programmatic requirements.
- Employ no-cost or minimal-cost measures that carry LEED credits. For example, water efficiency, as well as low-emission paints, adhesives and sealants do not affect project design, but only require product selection and specification.

- Evaluate moderate to high-cost measures by weighing first cost against return on investment, including lower operating cost, improved employee productivity, community benefits and environmental benefits. Emphasize synergy between measures.

Submittal

Instructions for submitting forms by fax and e-mail are located at the bottom of the forms

Submit by E-Mail: ELCCA@des.wa.gov

Review

The ELCCA Reviewer studies the Green Building Options forms for completeness and acknowledges receipt. If there are questions, the ELCCA Reviewer may contact the architect and/or owner's representative for clarification. Once the Green Buildings Options forms have been submitted, the ELCCA Analyst may proceed with development of the Work Plan. If GA is providing the ELCCA review, GA can provide limited design, technical assistance, and information on financial incentive programs.

Figure 3.1 Environmental Design Considerations

Version 1.0 October 2005

Project Title:			Date:		
Owner:			Owner's Rep:		
Owner's Project No:			Owner's Phone No:		
Owner's E-mail:			Owner's Fax No:		
Completed by:			Phone No:		
Firm:			E-mail:		
Bldg Type:					
Approx. sq. ft:		☐ New		☐ Remodel	☐ Addition

The following are elements of an energy efficient design and can contribute to LEED™ points. Check 'Yes' to indicate items that will be considered in the High Performance Alternative of the Energy Life Cycle Cost Analysis

	Site Considerations		Yes	No	N/A
1)	Building orientated to optimize energy efficiency		☐	☐	☐
2)	Landscaping to provide solar shading		☐	☐	☐
	Envelope		☐	☐	☐
3)	Energy Star™ compliant roof		☐	☐	☐
4)	Roof insulation to meet or exceed R-30 rigid or R-38 batt		☐	☐	☐
5)	Wall insulation with		☐	☐	☐
	a)	wood studs, R-19 batt insulation*	☐	☐	☐
	b)	metal studs, R-19 and rigid insulation on the exterior*	☐	☐	☐
	c)	mass wall, R-10 rigid insulation*	☐	☐	☐
6)	Windows:		☐	☐	☐
	a)	U=0.45 or lower*	☐	☐	☐
	b)	SHGC=0.45 (reduced cooling load) or lower*	☐	☐	☐
	c)	Exceed 50% Visual Light Transmittance (increased daylighting)*	☐	☐	☐
7)	Skylights U=0.60 or lower*		☐	☐	☐
8)	Doors U=0.50 or lower*		☐	☐	☐
	Lighting				
9)	Incorporate dalighting in over 50% of occupied critical visual task areas		☐	☐	☐
10)	Automated daylighting controls		☐	☐	☐
11)	Lumen maintenance controls (metal halide with electronic ballast)		☐	☐	☐
12)	Fluorescent lighting for the gym, multipurpose, commons or other High Bay application		☐	☐	☐
13)	Lighting power densities to meet or be lower than the following*		☐	☐	☐
	a)	Classroom: 1.15 watts per square foot (w/sf)	☐	☐	☐
	b)	Gym: 1.00 w/sf (1.8 w/sf over competitive area)	☐	☐	☐
	c)	Office: 1.10 w/sf	☐	☐	☐
	d)	Library: 1.30 w/sf	☐	☐	☐
	e)	Corridor: 0.70 w/sf	☐	☐	☐

* Represents ELCCA prescriptive elements

	Renewable Energy	Yes	No	N/A
14)	Incorporate solar photovoltaic (PV) technology:	☐	☐	☐
	a) for general building power	☐	☐	☐
	b) for isolated loads in remote locations (e.g. crosswalks)	☐	☐	☐
15)	Solar water heater	☐	☐	☐
16)	Wind power	☐	☐	☐
17)	Heat recovery systems	☐	☐	☐
18)	Geothermal	☐	☐	☐
	Water Conservation			
19)	Waterless Urinals	☐	☐	☐
20)	Rain water/gray water collection systems	☐	☐	☐
21)	Water efficient landscaping	☐	☐	☐
22)	Water efficient fixtures	☐	☐	☐
23)	Rep. w "sensor activated"	☐	☐	☐
	HVAC & Electrical			
24)	Natural ventilation	☐	☐	☐
25)	Displacement ventilation	☐	☐	☐
26)	Thermal Storage	☐	☐	☐
27)	Premium efficiency motors	☐	☐	☐
28)	Independent Building Commissioning Agent hired by owner	☐	☐	☐
29)	Variable flow fans and pumping systems	☐	☐	☐
30)	Heat recovery systems (between supply and exhaust)	☐	☐	☐
31)	Evaporative cooling to augment or replace mechanical cooling	☐	☐	☐
32)	High efficiency boilers (exceed code requirements)	☐	☐	☐
33)	High efficiency chillers (exceed code requirements)	☐	☐	☐
	Controls			
34)	Building automation system	☐	☐	☐
35)	Carbon Dioxide monitoring (gym/multipurpose/commons, etc.)	☐	☐	☐
36)	Demand control ventilation	☐	☐	☐
	Uninterruptible Power			
37)	Fuel cells for uninterruptible power systems	☐	☐	☐

List other energy efficient items or strategies that will be considered:

Submit to GA by
E-Mail: ELCCA@des.wa.gov

Figure 3.2 LEED Scorecard

The LEED™ Scorecard combines Green topics and energy efficiencies for an overall picture. This worksheet can be modified from planning to completion. For more information on applying for LEED™ ratings, visit the GA ELCCA or the GA Sustainable Design websites.

Project Title **Date**

LEED ®-NC Scorecard

Instructions

The scorecard is used to track your anticipated LEED™ score as your project progresses. The active spreadsheet sums the credit points for each category and provides a total score for the project. Values in the category subtotal and in the project total fields are done automatically.

The prerequisites are code requirements. "**Y**" (yes) appears adjacent in the first box and the other two are shaded. Beside each credit are three boxes. To score, put the number of points for that credit into the "**Y**" box, or in the "**?**" box if it is unsure, or in the "**N**" (no) box if this credit will not be pursued or is not applicable to the project. The possible points for each credit are shown in the far right column in each category. Energy & Atmosphere Credit 1.1 through 1.5 are each worth **two** points each.

The total number of points listed in the first box of the Total Project Score indicates the current anticipated score of the project. The ranges for each LEED certification category are listed below this row. A minimum of 26 points and achievement of all prerequisites is required to **certify** a project.

Y	?	N			
0	0	0	**Total Project Score**		**Possible Points 69**
			Certified 26 to 32 Silver 33 to 38 points Gold 39 to 51		Platinum 52 or more
0	0	0	**Sustainable Sites**	Possible Points	14
Y			Prereq 1	**Erosion & Sedimentation Control**	0
			Credit 1	**Site Selection**	1
			Credit 2	**Urban Redevelopment**	1
			Credit 3	**Brownfield Redevelopment**	1
			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
			Credit 4.3	**Alternative Transportation**, Alternative Fuel Refueling Stations	1
			Credit 4.4	**Alternative Transportation**, Parking Capacity	1
			Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
			Credit 5.2	**Reduced Site Disturbance**, Development Footprint	1
			Credit 6.1	**Stormwater Management**, Rate and Quantity	1
			Credit 6.2	**Stormwater Management**, Treatment	1
			Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof	1
			Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1
			Credit 8	**Light Pollution Reduction**	1
0	0	0	**Materials & Resources**	Possible Points	13
			Prereq 1	**Storage & Collection of Recyclables**	0
Y			Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1
			Credit 1.2	**Building Reuse**, Maintain 100% of Existing Shell	1
			Credit 1.3	**Building Reuse**, Maintain 100% Shell & 50% Non-Shell	1
			Credit 2.1	**Construction Waste Management**, Divert 50%	1
			Credit 2.2	**Construction Waste Management**, Divert 75%	1
			Credit 3.1	**Resource Reuse**, Specify 5%	1
			Credit 3.2	**Resource Reuse**, Specify 10%	1
			Credit 4.1	**Recycled Content**, Specify 25%	1
			Credit 4.2	**Recycled Content**, Specify 50%	1
			Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
			Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
			Credit 6	**Rapidly Renewable Materials**	1
			Credit 7	**Certified Wood**	1

Water Efficiency — Possible Points 5

Y	?	N			
0	0	0			
			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
			Credit 2	**Innovative Wastewater Technologies**	1
			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Energy & Atmosphere — Possible Points 17

Y	?	N			
0	0	0			
Y			Prereq 1	**Fundamental Building Systems Commissioning**	0
Y			Prereq 2	**Minimum Energy Performance**	0
Y			Prereq 3	**CFC Reduction in HVAC&R Equipment**	0
			Credit 1.1	**Optimize Energy Performance**, 20% New / 10% Existing	2
			Credit 1.2	**Optimize Energy Performance**, 30% New / 20% Existing	2
			Credit 1.3	**Optimize Energy Performance**, 40% New / 30% Existing	2
			Credit 1.4	**Optimize Energy Performance**, 50% New / 40% Existing	2
			Credit 1.5	**Optimize Energy Performance**, 60% New / 50% Existing	2
			Credit 2.1	**Renewable Energy**, 5%	1
			Credit 2.2	**Renewable Energy**, 10%	1
			Credit 2.3	**Renewable Energy**, 20%	1
			Credit 3	**Additional Commissioning**	1
			Credit 4	**Ozone Depletion**	1
			Credit 5	**Measurement & Verification**	1
			Credit 6	**Green Power**	1

Indoor Environmental Quality — Possible Points 15

Y	?	N			
0	0	0			
			Prereq 1	**Minimum IAQ Performance**	0
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	0
Y			Credit 1	**Carbon Dioxide** (CO_2) **Monitoring**	1
			Credit 2	**Increase Ventilation Effectiveness**	1
			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
			Credit 4.2	**Low-Emitting Materials**, Paints	1
			Credit 4.3	**Low-Emitting Materials**, Carpet	1
			Credit 4.4	**Low-Emitting Materials**, Composite Wood	1
			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
			Credit 6.1	**Controllability of Systems**, Perimeter	1
			Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
			Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
			Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Innovation & Design Process — Possible Points 5

Propose innovations for your project. Create specific titles for 1.1 to 1.4.

Y	?	N			
0	0	0			
			Credit 1.1	**Innovation in Design**: Specific Title	1
			Credit 1.2	**Innovation in Design**: Specific Title	1
			Credit 1.3	**Innovation in Design**: Specific Title	1
			Credit 1.4	**Innovation in Design**: Specific Title	1
			Credit 2	**LEED™ Accredited Professional**	1

Chapter 4

The Work Plan

What gets considered in the ELCCA study is as important as how the study is done, so it is the function of the Work Plan to outline the scope of the ELCCA in advance and to have the Analyst and the Reviewer discuss and agree on that plan. The Work Plan should propose to study alternatives that the project team can support and implement, and its development should involve the owner and project architect. The local utility can make a difference if incentives are offered for efficiency measures. A change to previous guidelines is a new requirement to model at least one High Performance Building Alternative. Note that a Work Plan is still required for prototypical buildings. The Work Plan is submitted by the ELCCA Analyst in the schematic design phase of a project.

Work Plan Preparation

The Work Plan form is shown as Figure 4.1. This form is also available in electronic format at http://www.des.wa.gov/services/facilities/energy/elcca. The following sections provide additional guidance in developing the Work Plan.

Prescriptives

Prescriptive levels for envelope and lighting systems are presented in Tables 4.1 and 4.2. If the design incorporates a prescriptive, there is no need to analyze alternatives for that system. The report then only needs to show how it meets the prescriptive. If the Analyst proposes a design that does not meet a prescriptive, a life cycle cost analysis must compare the proposed design to the prescriptive. Should a prescriptive approach be indicated in the Work Plan but later not followed through in the design, the appropriate analysis shall be added to the ELCCA by the Addendum. Some latitude may be allowed, at the Reviewer's discretion.

Building Envelope

Provide details of the planned envelope components. The prescriptive envelope requirements are shown in Table 4.1. If the planned design is equivalent to or exceeds the prescriptive, no further life cycle cost analysis is required. If not, the report will include the comparison (full life cycle costing) of both the proposed design and the identical building with a fully prescriptive envelope.

Lighting Systems

Provide details by functional area of the lighting components that are planned. The prescriptive lighting requirements are shown in Table 4.2. If the components selected are considered to meet or exceed the prescriptive, no further life cycle cost analysis for lighting systems is required. If not, the report will include the comparison (full life cycle costing) of both the proposed design and the identical building with a fully prescriptive lighting system.

Table 4.1 Envelope Components: **Prescriptive Levels for New Construction**

	Option 1 (Light Wall)	**Option 2 (Mass Wall)**
Roof	R-38 batt R-30 rigid	R-38 batt R-30 rigid
Wall	U=0.084minimum	Mass Wall with U=0.10 minimum and Specific Heat >=9 btu /sf deg F
Windows (wall area at 30% Max)	U=0.45	U=0.45
Skylight	U=0.60	U=0.60

- U-factors shall be from applicable WSEC default values from Chapter 10 or by approved calculation
- R values are ratings and only valid if insulation is applied per manufacturer's recommendations
- Values and factors above exceed code in many cases but may not meet local code for certain applications

Table 4.2 Prescriptive Lighting Power Densities

Facility Type	Space Type	Prescriptive Levels* (watts/square foot)
Schools	Classroom	1.15
	Gymnasium	1.00
	Office Area	1.10
	Library	1.30
	Corridor	0.70
	Locker rooms	0.80
Office Buildings	Overall Building	1.10
Warehouse	Overall Building	0.50
Assembly	Overall Building	1.00

***** Where governing code requires a lower value, use that value in lieu of the prescriptive level shown

Mechanical Systems
There are no prescriptive mechanical systems. Two mechanical system alternatives, as a minimum, shall be analyzed.

Renewable Energy System
The report must analyze one system that uses renewable energy. Table 4.3 presents acceptable options; others may be proposed by the Analyst.

Table 4.3 Renewable Examples

Renewable Resource	Acceptable System Options
Waste Heat Recovery	Exhaust gas / Ventilation air heat exchanger
Solar Energy	Photovoltaic cells or solar water heater
Wind	Wind generator
Biofuel	Wood chips in heating boiler
Geothermal	Ground source heat pumps

High Performance Building Alternative HPB
The Analyst must include one alternative that is considered equivalent to a U.S. Green Building Council LEED NC Silver Rating, with a minimum of four points in the "Optimize Energy Performance" category of the LEED NC Checklist. The Work Plan should reflect the strategy for the HPB, including what will be analyzed and what enhancements are intended for reaching the energy savings goal. This analysis uses a modified Energy Cost Budget calculation to compare the alternatives (see Chapter 5). The HPB may consist of:

- One of the alternatives already studied, if it meets the energy goal
- An enhancement of an already studied alternative if it meets the energy goal
- A separate system alternative, enhanced as needed, to meet the goal
- An integrated design option with envelope, lighting, and mechanical system variations.

Integrated Design
Energy systems behave interactively, and it is possible to analyze the life-cycle costs for an alternative that incorporates changes to more than one energy system at once. This integrated design approach is in contrast to the more traditional "system-by-system" approach where one energy system is analyzed at a time. An example of integrated design is a building designed with daylighting controls, high performance glazing, and natural ventilation, which then reduces the size of the mechanical systems and the associated operating costs. The integrated design approach may be especially useful for the High Performance Building alternative. Information on using building simulation software to calculate life-cycle costs of integrated energy systems can be found in Chapter 5.

Domestic Hot Water (DHW)
If the hot water energy use is expected to amount to 10% or more of the total annual energy use on a cost basis, then two DHW alternatives must be considered and described in the Work Plan. The two alternatives should be substantially different systems, both meeting all applicable codes and functional requirements.

Other Energy Systems
Particular building projects may involve energy systems not specifically described previously. Examples may include:

- Cogeneration Equipment
- Photovoltaic Systems
- Emergency Power Systems
- Uninterruptible power systems

Such systems should be noted on the work plan, and described in the report. Work plan discussions should focus on whether these might benefit from doing comparisons of alternatives in the Life Cycle Cost Analysis.

Note: If emergency power systems or uninterruptible power systems are being considered, a fuel cell shall be evaluated as one of the alternatives pursuant to RCW 43.19.651.

Work Plan Review and Approval

The ELCCA Reviewer studies the Work Plan, suggests improvements, and approves the Work Plan with or without comments. A copy of the approved Work Plan is faxed or e-mailed to the Analyst. The Analyst forwards a copy of the approved Work Plan to the building owner and the project architect. The Analyst then proceeds with the ELCCA report.

Figure 4.1 ELCCA Work Plan

1. Project Description

Project Title:				**Date:**	
Owner:		**Owner's Proj. #:**		**Location :**	
Building Size:	**SF**	**New:**	**SF**	**Remodel:**	**SF**
Building Only Cost Estimate:			**Site Cost Est.:**		
Useful Life:	**30 Years**	**Functional Areas:**			
Areas (Cont.)					
Electric Utility:			**Gas Utility:**		
Design Phase:		**VE Date:**		**Est. Bid Date:**	
Energy Software:		**Energy Savings Goal**	**30%**	**Weather Station:**	
Report Format:	☐	**Detailed Analysis**	☐	**Prototypical Design**	

2. Work Plan Contacts

Contact	Name	Organization	Email Address	Phone	Fax:
Analyst:					
Owner's PM:					
Architect:					
Other:					

3. Building Envelope

		Framing Type	Insulation Type	R-Value	Area (sf)
Roof/Ceiling 1	**Prescriptive:**				
	Proposed:				
Roof/Ceiling 2	**Prescriptive:**				
	Proposed:				
		Framing*	**Insulation Type****	**U Factor**	**Area (sf)**
Wall 1	**Prescriptive:**				
	Proposed:				
Wall 2	**Prescriptive:**				
	Proposed:				
		Frame Type	**U Factor**	**SHGC *****	**Area (% wall)**
Window 1	**Prescriptive:**			**N/A**	
	Proposed:				
Window 2	**Prescriptive:**			**N/A**	
	Proposed:				
Skylight	**Prescriptive:**			**N/A**	
	Proposed:				
		Type	**Insulation**	**U factor**	**Area (sf)**
Doors	**Proposed:**				
		Framing	**Insulation**	**R-Value**	**Area (sf)**
Floor	**Proposed:**				
		Type	**Insulation**	**R-Value**	**F Factor**
Slab Perimeter	**Proposed:**				

*** Framing for walls show as for example: 2" x 6" wood studs 16" o.c.**

**** Insulation for walls show as for example: "R-19 between studs"**

*****Solar Heat Gain Coefficient**

3. Building Envelope (Cont.)

Envelope Alternatives If Envelope prescriptives are not met, analyze 2 alternatives

Envelope Alternative 1:

Envelope Alternative 2:

4. Lighting Systems

Proposed Lighting	Space 1	Space 2	Space 3	Space 4
Space Name:				
Area Function*:				
Fixture Type:				
Ballast Type:				
Lamp Type:				
# Lamps/Fixture:				
Proposed LPD (w/sf)				
Prescriptive LPD (w/sf)*				
Check box below when space is likely to include feature indicated at left				
LED Exit Signs?	☐	☐	☐	☐
Occupancy Controls ?	☐	☐	☐	☐
Active Daylighting?	☐	☐	☐	☐
Lumen Maint. Controls?	☐	☐	☐	☐
Area Sweep Controls?	☐	☐	☐	☐

*** Use "Area Function" and prescriptive LPDs listed in T4.2, If not listed use local energy code target values**

Lighting Alternatives If Lighting prescriptives are not met, analyze 2 alternatives

Lighting Alternative 1:

Lighting Alternative 2:

5. Mechanical, Renewable , and High Performance Alternatives

Describe System Types, use areas, fuels, efficiencies, modeled energy saving features, etc.

Mechanical Alternative:

Mechanical Alternative:

Renewable Alternative:

High Performance Building Alternative:

6. Control System Features

	Description		Description
☐	Optimized Start/Stop	☐	Ventilation Rate Monitor
☐	Economizer Cooling	☐	Commissioning Diagnostics
☐	Trending Capability	☐	Demand Controlled Ventilation
☐	Evening Purge Cycle	☐	CO2 Monitoring
☐	Morning Warm-up	☐	Other

7. Domestic Hot Water (DHW) System

		Space 1	Space 2	Space 3
Space Name				
Number of Units:				
Energy Source:				
Unit Capacity KBTU/ hour:				
Tank Gallons/unit:				
Check if Point of Use Type:		☐	☐	☐
Check if Circulation pump used:		☐	☐	☐
Time Clock or EMCS:	For Heater or Burner	☐	☐	☐
	For Circulation Pump	☐	☐	☐

DHW Alternatives If DHW Sys. energy use is 10% or more of total bldg.use, Analyze 2 alternatives

DHW System Alternative 1

DHW System Alternative 2

8. Other Energy Systems (Describe):

9. Reviewer's Comments:

Mail Work Plan Package to:
ELCCA Reviewer
Dept. of Enterprise Services
Engineering and Architectural Services, Energy Program
1500 Jefferson Street SE, 2-North
P.O. Box 41476
Olympia, WA 98504-1476

Chapter 5

Energy Use Simulation and Economic Analysis

This chapter provides information and tools needed to perform the energy use simulation and economic analysis required for the ELCCA. The energy consuming systems selected in the Work Plan are analyzed to identify and document the total cost of ownership of each system over its life.

The annual cost of energy use, hereafter called the Design Energy Cost (DEC), is calculated through an hourly building simulation model, and along with the annual cost to operate, maintain, repair, and replace equipment is compared on an equal basis for each alternative over the life of the system.

Energy Use Calculation

Calculating annual energy use involves computer modeling of the energy behavior of buildings over time. The computer model simulates the time-based phenomena that affect a building's energy use, e.g., hourly occupancy schedules, thermal mass response, and HVAC control sequences. Items expected to be redundant in all system types modeled (e.g. restroom, kitchen exhaust, etc) are included in each analysis. Standards for the analyses include:

- The building components and operation shall be in minimum compliance with the Washington State Energy Code (WSEC) or a version of ASHRAE 90.1, referenced by the applicable LEED version.
- Each simulation shall be performed by a computer program that is capable of simulating the energy performance of building systems on an hourly basis.
- The annual DEC of each alternative shall be calculated using the same simulation program, the same operating conditions, the same weather data and the same purchased energy rates.
- The simulation of the selected alternatives must be complete and consistent with the operating scenarios of systems being studied. If integrated design alternatives are proposed, the alternatives must include all first cost and operation and maintenance (O&M) differences in building configuration, thermal mass, HVAC and lighting controls.

Approved Simulation Models

A computer energy simulation is required for the ELCCA analysis to compare the energy impacts of design alternatives. Approved computer software programs are listed below. These programs have been extensively tested and widely used. Other commercially available software specifically created for building simulations will be considered with prior approval from the ELCCA Reviewer.

- Carrier HAP
- Energy Plus
- DOE-2 & variations
- Trane Trace 700

It is the responsibility of the ELCCA Analyst to select the computer program that best evaluates the alternatives to be studied. The program selected must be one in which the Analyst has sufficient experience to produce accurate results. If modeling assumptions are accurate, a skilled Analyst can make appropriate comparative estimates of the various design alternatives.

Existing software may not be able to accurately model certain complex and innovative measures. In these cases, the ELCCA Analyst and the ELCCA Reviewer should agree on the calculation method and techniques that will be used to evaluate the measure.

Developing the Model

The following are guidelines for selecting the systems and analysis methods to be used.

Building Envelope Systems: Components meeting or exceeding prescriptive levels (See Table 4.1) may be used without additional analysis. If prescriptive requirements are not met, each component is to be analyzed as part of the ELCCA.

Lighting Systems: Components meeting or exceeding prescriptive levels (See Table 4.2) may be used without additional analysis. If prescriptive requirements are not met, each component is to be analyzed as part of the ELCCA.

Building Mechanical Systems: ELCCA guidelines require that a minimum of two *distinctly* different HVAC systems be analyzed.

Renewable Energy System: One renewable energy system alternative is to be analyzed. Table 4.3 lists some renewable energy alternatives; the Analyst may propose others. If the renewable alternative is integrated into the mechanical system, the Analyst should use the simulation model to determine DEC wherever appropriate. If the renewable alternative is to stand alone, or not integrated in the mechanical system, the analysis is to be based on an estimate of 30-year life-cycle cost, where approved by the Reviewer.

First Cost Interactions: Certain alternatives produce benefits beyond simply saving energy costs and improving occupant comfort. For example, alternatives that reduce transmission heat gains or internal heat gains may reduce the first cost of mechanical cooling systems as well as save energy dollars. The added cost of increased roof insulation or high efficiency electronic ballasts may be at least partially offset by downsized chillers, cooling coils, chilled water piping, pumps, ductwork, and fans.

High Performance Building Alternative: This alternative may be based on one of the systems indicated above, or may be as developed in the Work Plan. It will be compared with the Energy Cost Budget, or Code Baseline (described later in this chapter) to establish that the LEED NC energy savings goal is met.

Integrated Design Alternatives: The Analyst should examine integrated design alternatives by using the computer energy simulation to calculate energy usage for all interactive alternatives. The iterative or rolling baseline, method is the preferred way to account for interactions among various energy-efficiency measures, i.e.:

1. Incorporate into the reference baseline model any envelope measures that have a lower life-cycle cost than the reference baseline.
2. Add any lighting measures that have lower than the reference baseline.
3. Analyze HVAC alternatives with the proposed envelope and lighting incorporated.

Include a description of all analyzed systems or combination of systems in the ELCCA report and show details of envelope, lighting, and HVAC systems in their respective sections. Changes in first cost and annual maintenance cost of the various components and system must be fully accounted.

Domestic Hot Water (DHW): The baseline domestic hot water system should be the lowest first-cost system that is acceptable to the building owner. If the baseline system use exceeds 10% of the overall building energy use, alternatives must be analyzed.

Table 5.1 Typical Occupancy Densities, Receptacle Power Densities, and Hot Water Usage

The following values should only be used if specific design information is not available.

Building Type	Occupancy (sf/person)	Receptacle (watts/sf)	DHW (Btu/person-hr)
Assembly	50	0.2-0.4	215
Health/Institutional	200	1.0-1.5	135
Office	275	1.0-1.5	175
School	75	0.5-1.0	215
Warehouse	15,000	0.1-0.3	225

Input Assumptions

Envelope U-factors: Calculate effective U-factors for all envelope components to comply with 2005 *ASHRAE Handbook - Fundamentals*. The effects of window frames, stud walls, insulation voids, thermal bridging, sloped roofs, and other losses are to be accounted for in the calculations. Metal stud walls should use code (WSEC Table 10-5B) default values.

Infiltration: Infiltration losses depend on facility use. The values used in the analysis should be stated clearly and well justified in the report.

Glazing and solar heat gain coefficients: The manufacturer's tested window unit U-factor and shading coefficients should be used if available. If the specific window is unknown, use established default U-factors appropriate for the type of window considered. Input should include window frame, not just center of glass

Occupant Loads: Latent and sensible heat given off by occupants should be adjusted to reflect activity and actual occupancy levels for each zone.

Lighting: Table 4.2 provides prescriptive power densities for various building types. Input the lighting power density for each HVAC zone of the model. Corridors may have less density, while drafting rooms may have more. Do not select a global building code default value for lighting power densities. Include off-hour activities and custodial work in the hours of operation.

System and occupancy schedules: Use the actual building schedules or the default occupancy schedules found in the WSEC, Appendix, Reference Standard 29 (RS-29).

Miscellaneous equipment loads: Use rated equipment capacities if the simulation offers a load diversity factor or calculates the equipment load using an operating schedule profile that permits fractional amounts. Do not use default values for the entire building.

Critical HVAC parameters: Every input should be realistic using manufacturer's data if available important parameters to check are equipment capacities, diversities, percentage of outside air, economizer cooling setpoint, and efficiencies for motors, fans, pumps, and heating and cooling equipment. Part-load efficiencies should be used when available. Design loads output should include “hours loads not met” information for each alternative.

Zoning: Model zoning should be based on the expected HVAC design zoning. However, there may be fewer zones in the model. Use the following basic criteria:

- Usage—similar internal loads
- Controls type—same setpoint and operation schedule
- Solar gains—rooms with greatly differing gains should not be in the same zone
- Perimeter or interior locations—12 to 15 feet from exterior in one zone
- Fan or HVAC system type

Temperature setpoints: Thermostat settings should reflect the buildings expected operation.

High Performance Building Alternative Analysis

The High Performance Building Alternative represents a new requirement added in 2001 to RCW 39.35.030 to study a LEED NC Silver rated building. This has been defined as a building that earns four (of a possible 10) points for *Optimize Energy Performance*, using the USGBC energy analysis protocol. These points are given on the basis of the percent energy cost savings of the proposed Design Energy Cost (DEC) as compared to a code baseline model or “Energy Cost Budget (ECB)” that complies with ASHRAE 90.1. The version of 90.1 used depends on what is called for by the applicable version of LEED used by the project. Under LEED NC version 2.1 the percent savings required are 30% for new construction and 20% for remodels. The general savings formula:

Percent Savings = 100 X (ECB – DEC) / ECB

Once the percent energy cost savings goal is established, the annual, first and replacement costs of all the system enhancements, plus those of the base mechanical system used, are inserted into the ELCCA spreadsheet so that the results are comparable to the mechanical system alternatives.

In the event the percent savings does not reach the savings goal, the Analyst shall consider additional enhancements to the High Performance Building alternative and re-run the simulation to determine the DEC for the enhanced model, until the percent savings goals are met. Upon reaching the target savings percentage, the Analyst can prepare the final estimated construction and maintenance cost of the High Performance Building alternative, and proceed with completion of the ELCCA report.

Economic Analysis

An ELCCA spreadsheet is available for the economic analysis portion of the report. The spreadsheet is available electronically at http://www.des.wa.gov/services/facilities/energy/elcca and a sample is provided in Figure 5.1. The information needed to complete the spreadsheet includes:

- Construction costs (include utility incentive where applicable)
- Periodic equipment replacement costs
- First-year maintenance costs
- Annual Design Energy cost (DEC) for each fuel type
- Fuel price escalation (over and above general inflation)
- Real discount rate

The spreadsheet calculates the following for each year of the facility's economic life:

- Total annual costs
- Present worth factor, 1/(1+i)^n, where n = year, i = discount rate
- Present worth of annual costs
- Present worth of cumulative costs (30-year life-cycle cost)

The present worth of cumulative cost is the sum of the present worth of annual costs over the study period, known as “net present value” or “30-year life-cycle cost.”

ELCCA Analysts should use the escalation rates presented in Tables 5.2 and 5.3. There may be reasons to deviate from these regional average escalation projections in certain utility service areas where unusual economic or demographic conditions exist. The ELCCA Analyst may elect to perform an “escalation sensitivity analysis” by calculating life-cycle costs. First use the escalation rates given in the following table, and again use assumed local escalation rates, document the local rates and their source, and explain why they were chosen

Figure 5.1 ENERGY LIFE CYCLE COST SPREADSHEET

ELCCA2005.xls 17-Nov-05

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

- PROJECT: Facility Name (Firm Name)
ALT. No.: Description (Analyst's Name)

----------D I S C O U N T & E S C A L A T I O N Real Rates as of November 2004----------

Enter 1 or 0 for each fuel type:			Years:	Rate:
	1 = Yes	Real Discount Rate (i)	2005 - 2,040	2.0%
	0 = No	Electricity	2005 - 2,015 . . .	1.0%
IOU Electricity Source*	1	(Investor Owned Utility)	2,016 - 2,025 . . .	2.0%
POU Electricity Source**	0		2,026 - 2,040 . . .	2.0%
Natural Gas Fuel?	1	Natural Gas	2005 - 2,015 . . .	1.0%
Propane Fuel?	0	And other fossil fuels	2,016 - 2,025 . . .	1.0%
Oil Fuel?	0		2,026 - 2,040 . . .	1.0%
		Maintenance	2005 - 2,040	2.0%
		Inflation (Nominal , not used)	2005 - 2,040	3.0%

* IOU = Invester Owned Utility
** POU = Publicly Owned Utility

$3,312,896 **=30-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	Present Worth of Cumulativ
2,005	$200,000	$1,000	$12,000	$100,000	$113,000	(1+i)^-n	Costs	Costs
2,005	$200,000	--	--	--	$200,000	1.00	$200,000	$200,000
2,006	0	1,020	12,120	101,000	114,140	0.98	111,902	311,902
2,007	0	1,040	12,241	102,010	115,292	0.96	110,815	422,717
2,008	0	1,061	12,364	103,030	116,455	0.94	109,738	532,455
2,009	0	1,082	12,487	104,060	117,630	0.92	108,672	641,127
2,010	0	1,104	12,612	105,101	118,817	0.91	107,616	748,743
2,011	0	1,126	12,738	106,152	120,016	0.89	106,571	855,314
2,012	0	1,149	12,866	107,214	121,228	0.87	105,536	960,850
2,013	0	1,172	12,994	108,286	122,452	0.85	104,511	1,065,362
2,014	0	1,195	13,124	109,369	123,688	0.84	103,496	1,168,858
2,015	20,000	1,219	13,255	110,462	144,937	0.82	118,899	1,287,757
2,016	0	1,243	13,388	111,567	126,198	0.80	101,497	1,389,253
2,017	0	1,268	13,522	113,798	128,588	0.79	101,391	1,490,644
2,018	0	1,294	13,657	116,074	131,025	0.77	101,286	1,591,931
2,019	0	1,319	13,794	118,396	133,509	0.76	101,183	1,693,114
2,020	0	1,346	13,932	120,764	136,041	0.74	101,080	1,794,194
2,021	0	1,373	14,071	123,179	138,623	0.73	100,979	1,895,173
2,022	0	1,400	14,212	125,642	141,254	0.71	100,879	1,996,052
2,023	0	1,428	14,354	128,155	143,937	0.70	100,779	2,096,831
2,024	0	1,457	14,497	130,718	146,672	0.69	100,680	2,197,511
2,025	21,000	1,486	14,642	133,333	170,461	0.67	114,715	2,312,227
2,026	0	1,516	14,789	135,999	152,304	0.66	100,486	2,412,713
2,027	0	1,546	14,937	138,719	155,202	0.65	100,391	2,513,103
2,028	0	1,577	15,086	141,494	158,157	0.63	100,296	2,613,399
2,029	0	1,608	15,237	144,324	161,169	0.62	100,202	2,713,602
2,030	0	1,641	15,389	147,210	164,240	0.61	100,109	2,813,711
2,031	0	1,673	15,543	150,154	167,371	0.60	100,017	2,913,728
2,032	0	1,707	15,699	153,157	170,563	0.59	99,926	3,013,654
2,033	0	1,741	15,855	156,221	173,817	0.57	99,836	3,113,490
2,034	0	1,776	16,014	159,345	177,135	0.56	99,747	3,213,237
2,035	0	1,811	16,174	162,532	180,517	0.55	99,658	3,312,896
Totals:	$241,000 1st+Repl	$41,379 Maint	$421,593 Fuel	$3,767,464 Elec	$4,471,436 Total Annual		**$3,312,896**	**=30-year**

Table 5.2 Forecast of Inflation, Discount, and Maintenance Escalation Rates

Figures in percent per year			
	Nominal		Real
General Inflation	3.0%		0.0%
Discount	5.0%		2.0%
Maintenance escalation	5.0%		2.0%

Sources:
Discount Rate - Office of the State Treasurer
General Inflation Rate - Office of Financial Management

Table 5.3 Forecast of Fuel Price Escalation Rates

Real rates over and above the General inflation rate			
Fuel Type	**2005 – 2015**	**2016 – 2025**	**2026 – 2040**
#2 Fuel Oil	1.0 %	1.0%	1.0%
Natural Gas	1.0 %	1.0%	1.0%
Electricity Investor Owned	1.0 %	2.0 %	2.0 %
Public Utility	2.0 %	2.0 %	2.0 %

- Forecast figures for natural gas are for medium growth rates from the DRAFT Fifth Northwest Electric Power and Conservation Plan
- Forecast figures for #2 Oil are based upon medium low growth rates, from the DRAFT Fifth Northwest Electric Power and Conservation Plan
- Forecast figures for public utilities are from (DRAFT) Fifth Northwest Electric Power and Conservation Plan

Economic Building Life/Equipment Service Life
A default of 30 years has been set as the economic life. Equipment life is presented in Table 5.4. Deviations from the given values for both buildings and equipment may be used with prior approval by the reviewer. For equipment not found in this table, use published data or an estimate of life based on comparable equipment.

Construction and Equipment Replacement Costs
Provide an itemized system cost estimate (breakdown) for each alternative, analyzed by major equipment items. Costs include labor, materials, overhead and profit, and taxes. Utility incentives or rebates are not included in the analysis. Replacement cost for equipment should be based on replacing the equipment at the end of its expected life as shown in Table 5.4. For equipment replaced during the last 7 years of the economic building life, show its positive salvage value (using straight line depreciation) during the final year of the analysis. This would go into the “first and replacement cost” column as a negative dollar amount.

Maintenance Costs

Provide a breakdown of maintenance costs for each mechanical system analyzed. Estimate annual total HVAC maintenance costs for heating and cooling equipment and distribution systems for a building, and compare maintenance costs for various systems to a common baseline, to allow the cost of one system to be compared with that of another.

ELCCA Analysts may use the procedure explained below, or they may calculate annual maintenance costs using their own standard practice or using R.S. MEANS Facilities *Maintenance and Repair Cost Data* and/or *The Whitestone Building Maintenance and Repair Cost Reference*. Estimates based on standard practice must include a line-item breakdown of all costs; the same assumptions, procedures, and summary forms must be used to prepare all of the cost estimates.

Maintenance costs include all labor, materials, and consumable products for the following categories:

- Replacement/servicing (filters, belts, etc.)
- Lubrication
- General housekeeping
- Balancing/Control calibration
- Troubleshooting
- Service contracting (if any)
- Small equipment replacement (an allowance for periodic replacement within the service life of the measure)

Table 5.4 Equipment Service Life

Energy Conservation Measure/ Equipment	Median Life(yrs.)
Air Conditioners	
Window unit	10
Residential single or split package	15
Commercial through-the-wall	15
Water-cooled package	15
Single zone roof top	15
Multi zone rooftop	15
Heat Pumps	
Commercial air to air	15
Commercial water to air	19
Residential air to air	15
Boilers, hot water (steam)	
Steel water tube	24 (30)
Steel fire-tube	25 (25)
Cast iron	35 (30)
Electric	15
Burners	21
Furnaces	
Gas or oil-fired	18
Unit Heaters	
Gas or electric	13
Hot water or steam	20
Radiant Heaters	
Electric or gas	10
Hot water or steam	25
Air Terminals	
Diffuser, grilles, and registers	27
Induction and fan-coil units	20
VAV and double-duct boxes	20
Air Washers	17
Ductwork	30
Dampers	20
Fans	
Centrifugal	25
Axial	20
Propeller	15
Ventilating, roof mounted	20

Energy Conservation Measure/ Equipment	Median Life (yrs.)
Coils	
DX, water, or steam	20
Electric	15
Heat Exchangers	
Shell and tube	24
Compressors	20
Chillers	
Absorption	23
Centrifugal	23
Reciprocating	20
Cooling Towers	
Ceramic or FRP	34
Galvanized metal	20
Wood	20
Condensers	
Air-cooled	20
Evaporative	20
Insulation	
Molded	20
Blanket	24
Pumps	
Base mounted	20
Condensate	15
Pipe mounted	10
Sump and well	10
Reciprocating Engines	20
Steam turbines	30
Electric Motors	18
Motor starters	17
Electric transformers	30
Controls	
Electric	16
Electronic	15
Pneumatic	20
Valve actuators	
Hydraulic	15
Pneumatic	20
Self contained	10

Adapted from: *ASHRAE Handbook 2003 Applications*, Page 36.3, Table 3

Chapter 6

Preparing the Report

Present the information gathered from the energy use simulation and economic analysis as an easy-to-reference report, using these standards:

- 8.5” x 11” paper, bound to lie flat when opened, and printed double-sided
- Include a table of contents and number all pages
- Label each section
- Label each alternative system used in the computer model

Report Contents and Instructions

I. Title Page

Date
Project name
Building owner (also list public agency, if different than owner)
Analyst name, firm name and address

II. Table of Contents

List of Participants**:** Contact name, firm name, address, telephone and fax numbers for:
Building owner (also public agency and chief executive if different than building owner)
Project architect
Owner’s project manager
ELCCA Analyst
ELCCA Reviewer
Natural gas and electric utility representatives
Mechanical engineer
Electrical engineer
Lighting designer

III. Statement of Compliance

Provide a written declaration that the ELCCA report complies with RCW 39.35 and the ELCCA guidelines, signed and stamped by a professional engineer. The project architect signs the statement, indicating that he/she has reviewed the report and discussed it with the owner.

IV. Executive Summary

Describe the overall project including how the building will be operated. Identify the energy systems (envelope, lighting, HVAC, controls, and domestic hot water) that are recommended for inclusion in the building design. If the recommended systems were ***not*** the lowest life-cycle cost, provide an explanation.

A. Complete the Public Facility Energy Characteristics (PFEC) form (See Figure 6.4) with information for each of the recommended energy systems. If the project includes new construction and renovation, provide a separate form for each.

B. For the recommended systems, provide estimates of the building's annual energy costs and maintenance costs (use R.S. *MEANS Facilities Maintenance and Repair Cost Data* and/or *The Whitestone Building Maintenance and Repair Cost Reference*). Break the costs into two categories: dollars per year ($/yr) and dollars per square foot per year ($/sf/yr.).

C. Present two pie charts showing the recommended building's energy usage by “end use” and by “annual expenditure of energy dollars.” Devote individual “slices of the pies” to lighting, heating, cooling, fans, domestic hot water, and miscellaneous loads.

D. Create a table summarizing the costs for each alternative studied in the ELCCA, including the renewable energy and High Performance alternatives. Identify each system and its initial construction/installation cost, annual fuel cost, annual maintenance cost, total life-cycle cost, and the Energy Usage Index (EUI) in units of /sf/yr.

E. Provide a project timeline through construction.

F. Briefly describe technical or financial assistance to improve the project's energy efficiency that is available from natural gas and electric utilities.

V. Project Description

- Description of the site (elevation, orientation, shading, etc.)
- Basic facility description, especially non-energy systems
- Facility size, number of stories
- How the facility is to be used
- Occupancy schedules, both daily and annually
- Special facility considerations, e.g., noise control, aesthetics, environmental concerns
- Anything out of the ordinary that might affect the facility's energy use (e.g. foundry, pool, kitchen, welding or woodshop, etc.)
- Description of available campus-wide energy sources
- For renovation and addition projects, describe the existing facility and its existing energy systems

VI. Simulation and Economic Assumptions

Energy Simulation (Model) Assumptions
Describe the modeling program and input assumptions. Provide the building occupancy schedule, lighting and HVAC schedules, heating/cooling set points, thermal mass, site shading, and control strategies used as inputs.

Economic Assumptions

- Provide the utility rate assumptions and include a copy of the current utility rate schedules. Indicate any qualifications that must be met before the project can be served under this rate schedule.
- Provide the following escalation rate assumptions: electricity price, fuel price, maintenance, replacement, and discount factor.
- Indicate building owner assumptions (staff maintenance experience and equipment preferences).

VII. Building Envelope

- Describe the recommended envelope components (roof, wall, glazing, doors, floors, etc.), indicating materials, insulation values, and variations from prescriptive levels.
- Describe the prescriptive envelope, and any other envelope alternatives analyzed.
- Show typical sections and U-factor calculations for all construction types being recommended, (Figures 6.1, 6.2 and 6.3 provide sample formats).
- Describe assumptions used for infiltration and ventilation rates.
- If envelope alternatives are analyzed, for each alternative indicate the initial construction cost, projected annual maintenance costs, and estimated annual energy cost. Include life-cycle cost spreadsheets, energy simulation model with input changes highlighted, and output pages indicating estimated energy use.

VIII. Lighting Systems

- Describe the recommended system for each functional area of the building.
- Include the following information in tabular form for each functional area: room size, ceiling height, fixture type, ballast type, lamp type, number of lamps/fixture, number of fixtures/space, watts/fixture, and proposed lighting power density.
- Provide a typical fixture layout for each functional area.
- Describe daylighting zones, daylighting strategies, daylighting controls, and areas covered.
- If lighting alternatives are analyzed, for each alternative indicate the initial construction cost, projected annual maintenance costs, and estimated annual energy cost. Include life-cycle cost spreadsheets and load calculations.

IX. Mechanical Systems

For each alternative system include system description, single-line diagram, system advantages, input assumptions, energy simulation output, annual energy and maintenance costs, construction costs and the life-cycle cost spreadsheet.

X. Renewable Energy System

Provide a description of the renewable energy system(s) analyzed. Include input assumptions, construction cost, maintenance cost, energy costs/savings, energy simulation output and/or engineering calculations, the life-cycle cost spreadsheets, and description of a base case for comparison.

XI. High Performance Building Alternative

For the High Performance Building alternative include system description, single-line diagram, system advantages, input assumptions, energy simulation output, annual energy and maintenance costs, construction costs, the life-cycle cost spreadsheet, the specific measures implemented to reach the energy savings goal, and a description of building components that affect the energy use. Also show the percent energy cost savings calculation described in Chapter 5 and show that it meets the energy savings goal.

XII. Control Systems

Describe the recommended building control system. Include systems to be controlled, control features, and monitoring capabilities. Include features intended to facilitate energy conservation such as a direct interface to the utility electrical meter. Describe controls used to ensure adequate and efficient ventilation. Also include a completed Controls Checklist (Figure 6.5). Describe economizer control strategy.

XIII. Domestic Hot Water (DHW)

Describe the recommended DHW system. If alternatives are analyzed, provide insulation levels, AFUE, controls, energy simulation output, and cost estimates (annual energy cost, maintenance cost, material & labor costs).

XIV. Other Energy Systems

Describe other energy systems that impact energy use of this facility as discussed in Chapter 4, Work Plan. If alternatives are analyzed, include energy analysis, cost estimates and ELCCA spreadsheets.

XV. Appendices

Include the following, at a minimum, clearly identified:

A. Approved Work Plan
B. Computer input and output summary reports for the Energy Cost Budget model and for each alternative
C. Scaled floor plan showing the HVAC zones as modeled
D. Site plan including orientation
E. Letter of acknowledgement from Owner (if an alternative is recommended that doesn't have the lowest energy life-cycle cost

Abbreviated Report for Prototypical Design

If pre-approved at the Work Plan stage, an abbreviated report may be submitted for projects using a previously analyzed prototypical design. A copy of the original report for the prototypical design should be included with the report. An abbreviated report for a prototypical design must use the same format as a full report and contain the following:

- **Title Page**
- **Table of Contents**
- **List of Participants**
- **Statement of Compliance**
- **Executive Summary -** Identify prototype building/design and any changes made to the design. Complete a Public Facilities Energy Characteristics (PFEC) form.
- **Timeline -** Provide a project timeline through construction.
- **Project Description -** Include control system description, mechanical systems, ventilation strategies, etc.
- **Controls System Checklist**
- **Sections Describing Any Energy System Revised from the Prototypical Design** (envelope, lighting, HVAC, controls, or domestic hot water). A new energy use simulation and life-cycle cost analysis may be required as determined at the Work Plan stage.
- **Current Utility Rate Schedules**
- **Appendices**

Report Review

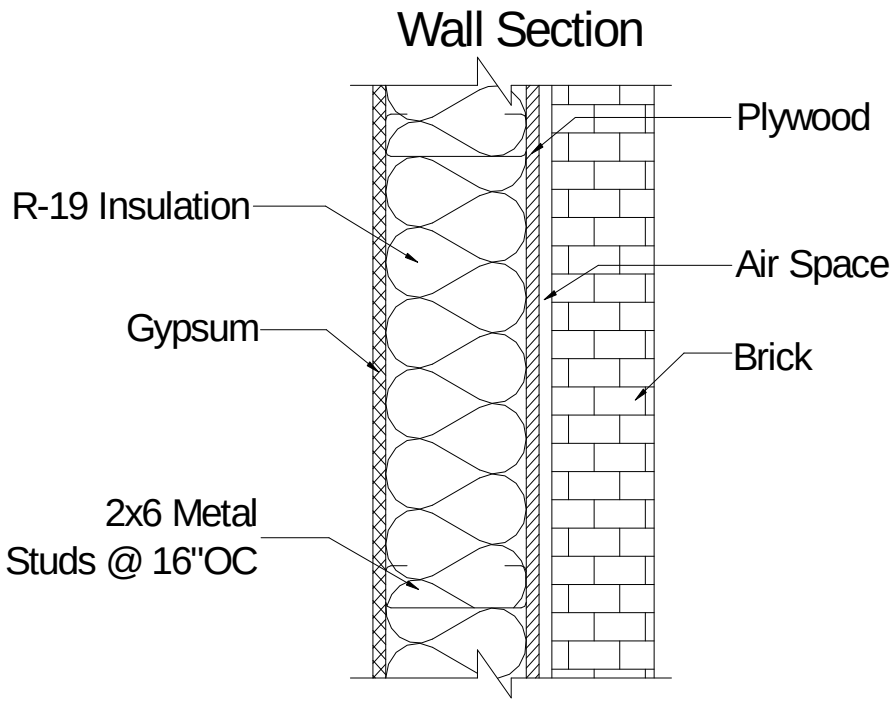
When evaluating the report, the ELCCA Reviewer will check for completeness and accuracy, and compare the analyzed systems to those agreed on in the Work Plan. The Reviewer will check that the report has been submitted prior to the project's scheduled value engineering date (if applicable) and that the report complies with these ELCCA guidelines.

The Reviewer will send a letter to the Analyst listing any questions or concerns about the report. The Analyst will have up to 30 days to respond to those questions or concerns in the form of an ELCCA Addendum. This process may then be repeated until all of the Reviewer’s concerns have been addressed (See Appendix C for “Review Process Checklist”).

Figure 6.1 Envelope Component U-factor Calculation

Example – Metal Framing

Element	R-value
Inside Air Film	0.68
½" GWB	0.45
Cavity, 2x6, 16” OC, R-19*	7.10
½" Plywood Sheathing	0.62
½" Air Space	0.90
4” Brick	1.20
Outside Air Film	0.17
Total R-value	11.12

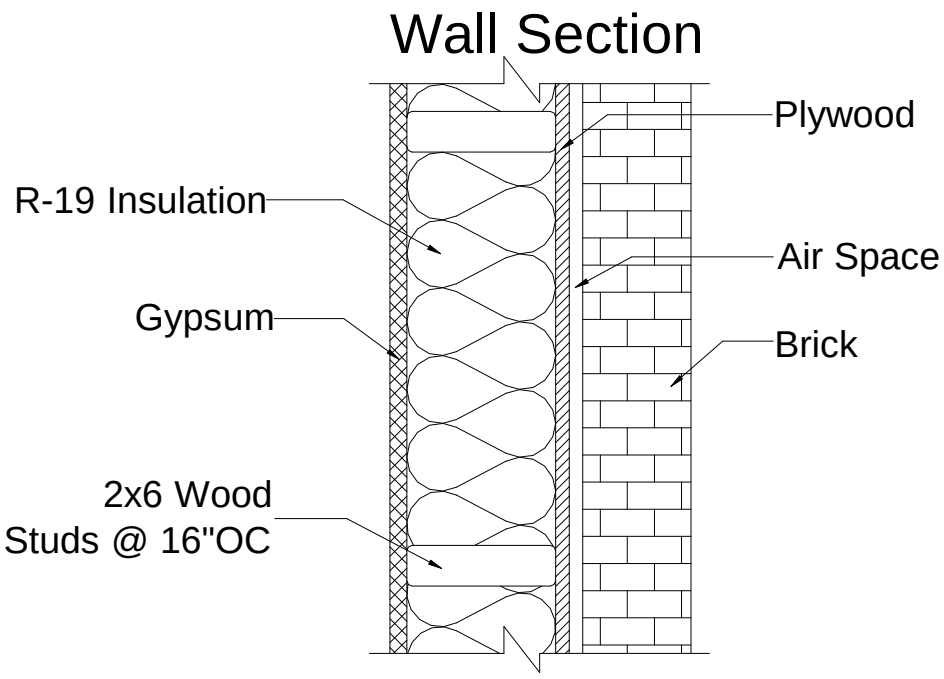


* See WSEC, Table 10-5A for metal framing R-Values

$$\text{U-factor} = \frac{1}{R} = \frac{1}{11.12} = 0.09$$

Figure 6.2 Envelope Component U-factor Calculation

Example – Wood Framing

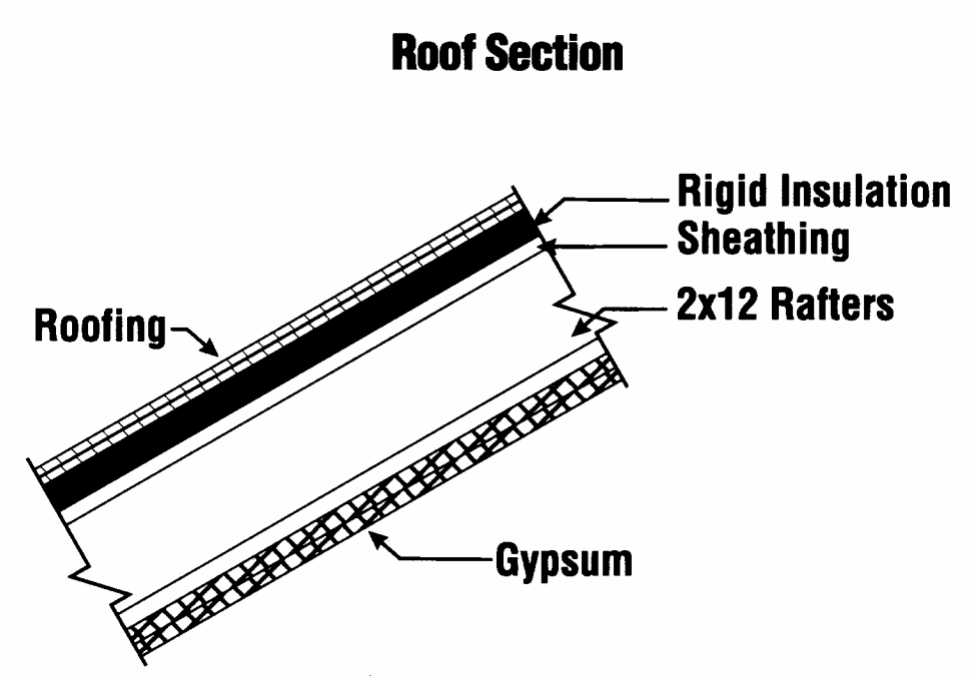


Between Framing Element	At Framing R-value	Element	R-Value
Inside Air Film	0.68	Inside Air Film	0.68
½" GWB	0.45	1/2" GWB	0.45
R-19 Insulation	19.00	2X6 Stud @ 16" O.C.	5.61
½" Plywood Sheathing	0.62	½" Plywood Sheathing	0.62
1/2" Air Space	0.90	1/2" Air Space	0.90
4" Brick	1.20	4" Brick	1.20
Outside Air Film	0.17	Outside Air Film	0.17
Total R-value	23.02	Total R-value	9.63
Framing Percentage			18%

U-factor =	Insulation Fraction* / Insulation R-value	+	Framing Fraction* / Framed R-value		
U-factor =	0.82 / 23.02	+	0.18 / 9.63	=	0.054

* Use cavity ratio in WSEC (Section #2005.2)

Figure 6.3 Envelope Component U-factor Calculation
Example – Wood Framed Roof



Between Framing		At Framing	
Element	R-value	Element	R-Value
Inside Air Film	0.61	Inside Air Film	0.61
2 layers ½" GWB	0.90	2 layers 1/2" GWB	0.90
12" Air Space	0.91	2" x 12" wood rafters @ 24" O.C.	12.00
5/8" Plywood Sheathing	0.77	5/8" Plywood Sheathing	0.77
Rigid Insulation	21.50	Rigid Insulation	21.50
Composite Shingle Roof	0.44	Composite Shingle Roof	0.44
Outside Air Film	0.17	Outside Air Film	0.17
Total R-value	25.30	Total R-value	39.39
Framing Percentage			13%

U-roof =	$\frac{\text{Insulated Fraction}}{\text{Insulated R-value}}$	+	$\frac{\text{Framed Fraction}}{\text{Framed R-value}}$	
U-roof =	$\frac{0.87}{25.30}$	+	$\frac{0.13}{36.39}$	= 0.038

Figure 6.4 Public Facilities Energy Characteristics

Agency Name	City	Reporting Date
Lake Trout School District	Clark Kent	1/15/2006
Project Title/Occupancy Type	**Project Number**	**No. of Occupants**
Elementary	2006002	700
Building Name	**Gross sf**	**Net Usable sf**
Lois Lane Elementary	75000	75000

Envelope Component*	Description		U	x A =	UA	% Total
Roof Type 1	Sloped Roof		0.03	44000	1320	18%
Roof Type 2					0	0%
Wall Type 1	Brick w/ metal Studs		0.094	28750	2702.5	37%
Wall Type 2	Brick w/ 10"CMU		0.072	4373	314.856	4%
Wall Type 3					0	0%
Door Type 1	Insulated Steel		0.055	500	27.5	0%
Door Type 2					0	0%
Window Type 1	High Performance	Frame Type Al.	0.48	4600	2208	30%
Window Type 2		Frame Type			0	0%
Floor Type 1					0	0%
Floor Type 2					0	0%

Perimeter Insulation		F-Factor	Length		
Thickness/Type	**R-Value**				
2"/Rigid	R-10	0.54	1500	810	11%

Gross Wall U Factor	UA max Code	UAmax - UA Total/UAmax x 100%		**UA Total**	
0.085	9400	21.46%		**7382.856**	**100%**

Mechanical

Heating Fuel	Cooling Plant	Heat Recovery		
Gas	Heat Recovery Chiller	**CFM**	**Type**	**Area Served**
		15,000	Exhaust	Gym/multi
AFUE	**COP**			
85%	5.5			
HVAC System Type(s)		**Minimum OSA**		**EUI (Btu/sf-yr)**
Water Source Heat Pump		11000		60,000

Lighting

	Wattage Outdoor	Wattage Indoor	Ltg. Power Density	Submitted by:
Building	16500 kW	82000 kW	1.1 W/sf	(Affix professional stamp and sign)
Area 1	**Fixture, Lamp, Ballast type:**		**Ltg. Power Density**	
Classroom	Pendant T-8 Direct/Indirect		1.05 W/sf	
Area 2	**Fixture, Lamp, Ballast type:**		**Ltg. Power Density**	
Library	Pendant T-8 Direct/Indirect		1.1 W/sf	
Area 3	**Fixture, Lamp, Ballast type:**		**Ltg. Power Density**	
Gym/Multi	Highbay Fluorescent		1.1 W/sf	
Area 4	**Fixture, Lamp, Ballast type:**		**Ltg. Power Density**	
Admin	Parabolic T-8		1 W/sf	
Firm Name/ELCCA Analyst				

Figure 6.5 Controls Checklist

Agency: **Project Title:**

Proposed Control Systems (describe):

Interior Lighting control

- ✓ Switched
- ☑ Occupancy Sensors
- ☐ Other (describe):
- ☐ Energy Management Control System (EMCS)
- ☐ Time Clocks

Exterior Lighting control

- ☐ Switched
- ☐ Photocell Control
- ☐ Other (describe):
- ☐ Energy Management Control System (EMCS)
- ☐ Time Clocks

Domestic Hot Water

Heater Control: ☐ Time Clock ☐ EMCS ☐ No Control

Circulation Pump: ☐ Yes ☐ No

Circ. Pump Control: ☐ Time Clock ☐ EMCS ☐ No Control

HVAC

Operating Schedules	**Typical Weekday**	**Typical Weekend**
Start Times:		
Stop times:		

Control System: ☐ Time Clock ☐ EMCS

Control Type: ☐ DDC ☐ Pneumatic

Features: ☐ Night Setback ☐ Override ☐ Morning Warm-Up Cycle

Thermostat Setpoints:

Heating	**Cooling**	**Night Setback**
71 Deg F	**80** Deg F	**55** Deg F

Ventilation Air Controls: ☐ CO2 Sensor ☐ VOC Sensor ☐ Occupancy Sensor Control of Outside Air Dampers

Economizer Controls: ☐ Dry Bulb Temperature Control ☐ Enthalpy Controls ☐ Integrated Control

Power Monitoring : ☐ Whole Building ☐ System Level ☐ Utility Meter Derived

Central Systems

Supply Air Temperature Heating/Cooling

Heating Reset Capabilities: ☐ Yes ☐ No Describe: _____

Cooling Reset Capabilities: ☐ Yes ☐ No Describe: _____

Water -Loop Temperatures

Heating Reset Capabilities: ☐ Yes ☐ No Describe: _____

Cooling Reset Capabilities: ☐ Yes ☐ No Describe: _____

Fan Control

Inlet Vane: ☐ Yes ☐ No Describe: _____

Variable-Speed Controller: ☐ Yes ☐ No Describe:

Chapter 7

ELCCA Addendum

The ELCCA Analyst prepares the Addendum early in the construction document phase. At this point, value engineering (VE) has taken place and the ELCCA Reviewer has reviewed and commented on the ELCCA report.

The addendum responds to and analyzes additional systems that affect energy performance as suggested by the VE team.

Submittal

The submittal consists of the ELCCA Addendum Letter (see Figure 7.1) and any and all supporting material documenting any changes to the report. There are two options when completing the ELCCA Addendum letter.

1) *If no changes are recommended,* the ELCCA Analyst checks the first box.

2) *When the owner has approved recommended changes,* the ELCCA Analyst checks the second box to inform the ELCCA Reviewer of the suggested changes. A revised Public Facility Energy Characteristics (PFEC) Form (prepared by the ELCCA Analyst) is submitted with the letter as well as any supporting documentation.

The Addendum letter is addressed to the ELCCA Reviewer. (Note: The address shown in the example is used when GA is the ELCCA Reviewer.) Copies of the letter go to the building owner, project architect, project manager, and utility representative.

The Reviewer may call or write the Analyst for additional clarification on the suggested changes before approving the Addendum.

Review and Approval

After any questions are resolved, the ELCCA Reviewer prepares a letter of recommendation and sends it to the owner with copies to the Analyst, project manager, and project architect. The letter verifies that the ELCCA report has been reviewed and recommends its approval.

Figure 7.1 ELCCA Addendum Cover Letter Format

Date: _____

Attention: ELCCA Reviewer
Department of Enterprise Services
Division of Engineering and Architectural Services
P.O. Box 41012
Olympia, WA 98504-1012

Re: Comment Letter
Project Description:

Dear ELCCA Reviewer:

I am in receipt of your comments dated _____. The following items address each of your comments, and indicate how each was resolved.

1.

2.

3.

These comments and their resolutions have been discussed with the Owner.

Sincerely,

ELCCA Analyst

cc Building owner, Project Architect, Project Manager

Enclosures if update is required
1. PFEC Form
2. Computer I/O
3. ELCCA Spreadsheets

Glossary of Terms

Analyst: The ELCCA analyst is the person responsible for the preparation of the ELCCA.

Annual Fuel Utilization Efficiency (AFUE): An efficiency descriptor of the ratio of annual output energy to annual input energy as developed in accordance with the requirements of U.S. Department of Energy (DOE) 10CFR Part 430.

Base Year: Calendar year upon which the analysis is based.

Building Automation System: A control system that uses sensors and actuators within a building that coordinate with various building systems to adjust for varying loads and occupancies.

Building Commissioning: A systematic and documented process of ensuring that the owner's operational needs are met, that building systems perform efficiently, and that building operators are properly trained.

Building Value: Replacement value of a building as determined by insurance coverage or independent appraisal (often depicted in dollars per square foot). The entire area of the building being remodeled should be considered when determining the building value.

BTU (British thermal unit): A unit of heat equal to the amount of heat required to raise one pound of water one degree Fahrenheit at one atmosphere pressure.

Carbon Dioxide Monitor: A device that detects carbon dioxide (CO_2) levels in an occupied zone. It may be used in conjunction with the building automation system to vary and check ventilation system performance.

Coefficient of Performance (COP): Ratio of the rate of heat delivered (heating mode) or heat removed (cooling mode) to the rate of total energy input to the unit, expressed in consistent units and under designated operating conditions.

Commissioning Diagnostics: Using the building automation system to run tests on building systems to identify if they are functioning correctly.

Day lighting: The use of sunlight to supplement electric lighting.

Demand Control Ventilation: The control of outdoor air quantities supplied to a space based on the number of occupants. This is typically done by monitoring carbon dioxide (CO_2) or volatile organic compounds (VOC) in the return air and then modulating the outside air damper to maintain the set level.

Discount Rate: Interest rate used to relate future costs (or benefits, such as salvage) to their equivalent present values. For the ELCCA process, the discount rate reflects the rate at which public institutions borrow money.

Displacement Ventilation: An air distribution system based on introducing cool air into the lower zone of an occupied space at a low velocity, while exhausting air from the upper portion of the occupied zone.

Economic Life: Projected or anticipated useful life span of a facility, used for the life-cycle cost analysis. While a facility may last longer than this period, any costs (or benefits) which may occur after this period need not be considered. When discounting is considered, any such costs (or benefits) are usually negligible.

Energy Efficiency Ratio (EER): A ratio of BTU per hour (/h) produced, divided by the number of watts used to produce the cooling.

Energy Life-Cycle Cost Analysis (ELCCA): Present value evaluation of a system conducted over the economic life of the system. The life-cycle cost includes the initial cost, salvage values, and the annual costs of energy consumption, periodic replacement, operation, and routine maintenance.

Energy Star Compliant Roof: A roof that reflects the sun's heat and prevents it from entering a building, thereby reducing the cooling load. It also reduces the “heat island” effects of the built environment.

Energy Systems: Includes the building envelope, lighting, mechanical, and domestic hot water (DHW) systems, and any other systems or components that account for 10% or more of the overall building energy consumption.

Energy Use Simulation: Calculation of all energy used by a facility (typically for one year), summarized for all energy systems and components by type of energy including the internal energy load imposed on a facility by its occupants, equipment, components, and the external energy load imposed on a facility by the climatic conditions at its location.

Evaporative Cooling: A system or process in which the heat is removed from an object by the evaporation of water.

F-factor: The perimeter heat loss of a slab-on-grade floor expressed in BTU/hr*ft* F.

Fenestration: Any light-transmitting opening in a building envelope, including windows, skylights, clerestories, and glass doors.

Fuel Cell: An electrochemical energy conversion device that converts the elements hydrogen and oxygen into water and, in the process, produces electricity and heat.

Green Building: *Verb:* Environmentally conscious construction method relating to site maintenance, energy usage, and material recycles. *Noun:* An efficient and sustainable structure.

Geothermal Heating/Cooling: A system that uses the earth as either a heat source or heat sink. It may involve a subterranean water source or well for heat and may include pipe loops.

Heat Recovery: The capture and reuse of heat energy that is generated during building operation that would otherwise be wasted.

High Performance Building Alternative (HPB): An alternative developed and studied in the ELCCA that meets the project energy cost savings goal so as to fully qualify for four LEED points under EA Credit 1 "Optimize Energy Performance, using the methods described by the applicable version of LEED.

Independent Commissioning Agent: A commissioning agent that works directly for the building owner and is neither a subcontractor to the architect or engineer nor an employee.

Indoor Air Quality (Acceptable) (IAQ): (from ASHRAE 62) Air in which there are no unwanted airborne constituents that may reduce the acceptability of the air as determined by cognizant authorities and with which a substantial majority of the people exposed do not express dissatisfaction.

Initial Cost (first cost or investment): Money required for the capital construction or renovation of a major facility. The initial cost includes the cost of building structures and all equipment, as well as project costs such as professional design fees, permits, tax, etc.

Integrated Design: Design in which two or more systems are analyzed as a unit in order to take advantage of positive interactions that are synergistic or greater than the sum of the parts.

LEED ®-NC (Leadership in Energy and Environmental Design): A registered trademark of the U.S. Green Building Council. A program and building rating system for new construction and remodel projects, developed and administered by the U.S. Green Building Council, www.usgbc.org.

Lighting Power Density (LPD): A building's lighting system described in watts per square foot (w/sf) (excludes plug-in task lighting).

Lumen Maintenance Control: An electrical control device designed to vary the light supplied by a lighting system in order to maintain a specified illumination level.

Maintenance Costs: Costs of maintaining HVAC, controls, lighting, DHW, and other building systems in good working order.

Major Facility: Any publicly owned or leased building having 25,000 square feet or more of "usable floor space." See RCW 39.35.030(3) Definitions in Appendix B.

MotorMaster+: U.S. Department of Energy computer software designed to help select efficient electric motors for a given application. The software also features motor inventory management tools, maintenance log tracking, efficiency analysis, savings evaluation, energy accounting, and environmental reporting capabilities. For more information and free software download, go to: http://www1.eere.energy.gov/manufacturing/tech_deployment/software_motormaster.html

Natural Ventilation: A ventilation system that uses the natural forces of wind and convection to deliver fresh air into buildings.

Net Metering: A simplified method of metering the energy consumed and produced at a home or business that has its own renewable energy generator, such as a wind turbine or solar panel. Under net metering agreements with utilities, excess electricity that is not used in the building will feed into the grid and spin the home or business electricity meter backwards. This provides the customer with full retail value for all the electricity produced.

Nominal Price Escalation: Gross price change of annual fuel and maintenance costs, including the effect of general inflation.

Photovoltaic (PV) Modules: Also known as a solar panel, a device that produces an electric current from incident solar radiation.

Project Costs: All costs associated with the building structure with the exceptions of unconditioned outdoor sports facilities, parking or landscaping, and work done to meet safety or health concerns such as seismic bracing, acoustic treatment, or fire sprinklers. Costs of the exceptions may be excluded from the stated project costs provided that the costs are not included in the building value.

Prototypical design: A building design intended for use on more than one site, resulting in two or more identical structures.

Real Price Escalation: Net price change of annual fuel and maintenance costs after adjusting for general inflation.

Renewable Resource: Non-fossil fuel energy source such as solar (active or passive), wind, biomass, geothermal, "waste" heat, refuse-derived fuels, etc. (See RCW 39.35.030(12) in Appendix B).

Renovation: Any additions, alterations, or repairs within any 12-month period which exceed 50 percent of the value of a major facility, and which will affect any energy systems.

Replacement Costs: One-time or periodic costs to be incurred in the future to maintain the original function of the facility or item.

Report: Energy Life-Cycle Cost Analysis Report, unless otherwise indicated.

Reviewer: Unless otherwise indicated, refers to the ELCCA Reviewer.

Rolling Base Line: An energy study methodology where, as alternatives are analyzed, the baseline is modified to include the preferred alternative and that in turn is used as the baseline for the analysis of the next alternative.

R-Value: A measure of a given material's ability to resist the absorption or conduction of heat energy, a characteristic also referred to as thermal resistance.

Salvage Value: The value of equipment at the end of its life-cycle period. (Salvage value is positive if it has residual economic value and negative if removal costs exceed equipment value.) For purposes of ELCCA, replacements included in the last 7 years of the analysis should have salvage values depicted in the last year based on a simple straight line depreciation, years of service, and average service life.

Seasonal Energy Efficiency Ratio (SEER): The total cooling of a central air conditioner (in BTUs) during its normal usage period for cooling (not to exceed 12 months), divided by the total electric energy input in watt-hours during the same period.

Solar Heat Gain Coefficient (SHGC): Measurement of how well a product blocks heat caused by sunlight. The SHGC is the fraction of incident solar radiation admitted through a window, both directly transmitted and absorbed, then subsequently released inward. SHGC is expressed as a number between 0 and 1. The lower a window's SHGC, the less solar heat it transmits.

Solar Hot Water: Generally, a hot water heating system that relies on solar radiation to heat potable water.

Solar Space Heating: A heating system using large windows and heat absorbent materials built into the sunlit floors and walls.

Sustainability: Method of using a resource responsibly so that the resource is not depleted or permanently damaged.

Therm: A unit of heat equal to 100,000 British Thermal Units.

Thermal Storage: The storage of heat or cold for use at another time.

U-Factor: The “Overall Heat Transfer Coefficient” (U) of an assembly of layers of different materials, calculated as the inverse of the overall thermal resistance, and expressed in BTU/hr-ft^2 –F.

Visible Light Transmittance: The ratio of visible light transmitted through a substance to the total visible light incident on its surface.

Waterless Urinals: A urinal that operates with a liquid trap rather than with water flow.

Wind Power: Electrical energy generated by harnessing the kinetic energy of air in motion (wind).

Enabling Legislation and Administrative Code

Revised Codes of Washington

RCW CHAPTER 39.35 Energy Conservation in Design of Public Facilities

Sections:

RCW 39.35.010 Legislative finding.

The legislature hereby finds:

(1) That major publicly owned or leased facilities have a significant impact on our state's consumption of energy;

(2) That energy conservation practices and renewable energy systems adopted for the design, construction, and utilization of such facilities will have a beneficial effect on our overall supply of energy;

(3) That the cost of the energy consumed by such facilities over the life of the facilities shall be considered in addition to the initial cost of constructing such facilities;

(4) That the cost of energy is significant and major facility designs shall be based on the total life-cycle cost, including the initial construction cost, and the cost, over the economic life of a major facility, of the energy consumed, and of the operation and maintenance of a major facility as they affect energy consumption; and

(5) That the use of energy systems in these facilities which utilize renewable resources such as solar energy, wood or wood waste, or other non-conventional fuels should be considered in the design of all publicly owned or leased facilities.

[1982 c 159 § 1; 1975 1st ex.s. c 177 § 1.]

RCW 39.35.020 Legislative declaration

The legislature declares that it is the public policy of this state to insure that energy conservation practices and renewable energy systems are employed in the design of major publicly owned or leased facilities and that the use of at least one renewable energy system is considered. To this end the legislature authorizes and directs that public agencies analyze the cost of energy consumption of each major facility to be planned and constructed or renovated after September 8, 1975. [1982 c 159 § 2; 1975 1st ex.s. c 177 § 2.]

RCW 39.35.030 Definitions

For the purposes of this chapter the following words and phrases shall have the following meanings unless the context clearly requires otherwise:

(1) "Public agency" means every state office, officer, board, commission, committee, bureau, department, and all political subdivisions of the state.

(2) "Department" means the state Department of Enterprise Services.

(3) "Major facility" means any publicly owned or leased building having twenty-five thousand square feet or more of usable floor space.

(4) "Initial cost" means the moneys required for the capital construction or renovation of a major facility.

(5) "Renovation" means additions, alterations, or repairs within any twelve-month period which exceed fifty percent of the value of a major facility and which will affect any energy system.

(6) "Economic life" means the projected or anticipated useful life of a major facility as expressed by a term of years.

(7) "Energy management system" means a program, energy efficiency equipment, technology, device, or other measure including, but not limited to, a management, educational, or promotional program, smart appliance, meter reading system that provides energy information capability, computer software or hardware, communications equipment or hardware, thermostat or other control equipment, together with related administrative or operational programs, that allows identification and management of opportunities for improvement in the efficiency of energy use, including but not limited to a measure that allows:

(a) Energy consumers to obtain information about their energy usage and the cost of energy in connection with their usage;

(b) Interactive communication between energy consumers and their energy suppliers;

(c) Energy consumers to respond to energy price signals and to manage their purchase and use of energy; or

(d) For other kinds of dynamic, demand-side energy management.

(8) "Life-cycle cost" means the initial cost and cost of operation of a major facility over its economic life. This shall be calculated as the initial cost plus the operation, maintenance, and energy costs over its economic life, reflecting anticipated increases in these costs discounted to present value at the current rate for borrowing public funds, as determined by the office of financial management. The energy cost projections used shall be those provided by the department. The department shall update these projections at least every two years.

(9) "Life-cycle cost analysis" includes, but is not limited to, the following elements:

(a) The coordination and positioning of a major facility on its physical site;

(b) The amount and type of fenestration employed in a major facility;

(c) The amount of insulation incorporated into the design of a major facility; (d) The variable occupancy and operating conditions of a major facility; and (e) An energy-consumption analysis of a major facility.

(10) "Energy systems" means all utilities, including, but not limited to, heating, air-conditioning, ventilating, lighting, and the supplying of domestic hot water.

(11) "Energy-consumption analysis" means the evaluation of all energy systems and components by demand and type of energy including the internal energy load imposed on a major facility by its occupants, equipment, and components, and the external energy load imposed on a major facility by the climatic conditions of its location. An energy-consumption analysis of the operation of energy systems of a major facility shall include, but not be limited to, the following elements:

(a) The comparison of three or more system alternatives, at least one of which shall include renewable energy systems, and one of which shall comply at a minimum with the sustainable design guidelines of the United States green building council leadership in energy and environmental design silver standard or similar design standard as may be adopted by rule by the department;

(b) The simulation of each system over the entire range of operation of such facility for a year's operating period; and

(c) The evaluation of the energy consumption of component equipment in each system considering the operation of such components at other than full or rated outputs.

The energy-consumption analysis shall be prepared by a professional engineer or licensed architect who may use computers or such other methods as are capable of producing predictable results.

(12) "Renewable energy systems" means methods of facility design and construction and types of equipment for the utilization of renewable energy sources including, but not limited to, hydroelectric power, active or passive solar space heating or cooling, domestic solar water heating, windmills, waste heat, biomass and/or refuse-derived fuels, photovoltaic devices, and geothermal energy.

(13) "Cogeneration" means the sequential generation of two or more forms of energy from a common fuel or energy source. Where these forms are electricity and thermal energy, then the operating and efficiency standards established by 18 C.F.R. Sec. 292.205 and the definitions established by 18 C.F.R. 292.202 (c) through (m) as of July 28, 1991, shall apply.

(14) "Selected buildings" means educational, office, residential care, and correctional facilities that are designed to comply with the design standards analyzed and recommended by the department.

(15) "Design standards" means the heating, air-conditioning, ventilating, and renewable resource systems identified, analyzed, and recommended by the department as providing an efficient energy system or systems based on the economic life of the selected buildings. [2001 c 214 § 16; 1996 c 186 § 402; 1994 c 242 § 1; 1991 c 201 § 14; 1982 c 159 § 3; 1975 1st ex.s. c 177 § 3.]

RCW 39.35.040 Facility design to include life-cycle cost analysis.

Whenever a public agency determines that any major facility is to be constructed or renovated, such agency shall cause to be included in the design phase of such construction or renovation a provision that requires a life-cycle cost analysis conforming with the guidelines developed in RCW 39.35.050 to be prepared for such facility. Such analysis shall be approved by the agency prior to the commencement of actual construction or renovation. A public agency may accept the facility design if the agency is satisfied that the life-cycle cost analysis provides for an efficient energy system or systems based on the economic life of the major facility. Nothing in this section prohibits the construction or renovation of major facilities which utilize renewable energy systems. 1994 c 242 § 2; 1982 c 159 § 4; 1975 1st ex.s. c 177 § 4.]

RCW 39.35.050 Life-cycle cost analysis—Guidelines.

The department, in consultation with affected public agencies, shall develop and issue guidelines for administering this chapter. The purpose of the guidelines is to define a procedure and method for performance of life-cycle cost analysis to promote the selection of low-life-cycle cost alternatives. At a minimum, the guidelines must contain provisions that:

(1) Address energy considerations during the planning phase of the project;
(2) Identify energy components and system alternatives including renewable energy systems and cogeneration applications prior to commencing the energy consumption analysis;
(3) Identify simplified methods to assure the lowest life-cycle cost alternatives for selected buildings with between twenty-five thousand and one hundred thousand square feet of usable floor area;
(4) Establish times during the design process for preparation, review, and approval or disapproval of the life-cycle cost analysis;
(5) Specify the assumptions to be used for escalation and inflation rates, equipment service lives, economic building lives, and maintenance costs;
(6) Determine life-cycle cost analysis format and submittal requirements to meet the provisions of chapter 201, Laws of 1991;
(7) Provide for review and approval of life-cycle cost analysis. [1996 c 186 § 403; 1994 c 242 § 3; 1991 c 201 § 15.]

RCW 39.35.060 Life-cycle cost analysis--Review fees.

The department may impose fees upon affected public agencies for the review of life-cycle cost analyses. The fees shall be deposited in the energy efficiency services account established in RCW 39.35C.110. The purpose of the fees is to recover the costs by the department for review of the analyses. The department shall set fees at a level necessary to recover all of its costs related to increasing the energy efficiency of state-supported new construction. The fees shall not exceed one-tenth of one percent of the total cost of any project or exceed two thousand dollars for any project unless mutually agreed to. The department shall provide detailed calculation ensuring that the energy savings resulting from its review of life-cycle cost analysis justify the costs of performing that review. [1996 c 186 § 404; 1991 c 201 § 16.]

RCW 39.35.090 Severability

If any provision of this act, or its application to any person or circumstance is held invalid, the remainder of the act, or the application of the provision to other persons or circumstances is not affected.

[1975 1st ex.s. c 177 5.]

Washington Administrative Code

WAC 180-27-075 Energy conservation report.

In compliance with the provisions of chapter 39.35 RCW, school districts constructing school facilities shall complete an energy conservation report for any new construction or for additions to and modernization of existing school facilities which will be reviewed by the Washington state department of Enterprise Services. One copy of the energy conservation report, approved by the district board of directors, shall be filed with the superintendent of public instruction. The amount of state assistance for which a district is eligible for the preparation of the energy conservation report shall be the state matching percentage multiplied by ten thousand dollars. The amount of state assistance for which a district is eligible shall be the state matching percentage multiplied by the fee charged.

[Statutory Authority: RCW 28A.525.020. 98-19-143, § 180-27-075, filed 9/23/98, effective 10/24/98. Statutory Authority: RCW 28A.525.020 and chapters 39.35 and 60.28 RCW. 92-24-027, § 180-27-075, filed 11/24/92, effective 12/25/92. Statutory Authority: RCW 28A.47.830. 83-21-066 (Order 11-83), § 180-27-075, filed 10/17/83.]

Review Process Checklist

This checklist is a guide to help verify that the analysis is properly documented and that the owner has the information needed to make viable decisions.

Project Title/Building Name:

_____

Agency/Project Owner:

_____

Reviewer: _____ Date: _____

Green Building Options

- ⑥ Environmental Design Considerations complete
- ⑥ LEED or Approved other similar checklist complete

Work Plan

- ⑥ Work Plan complete (envelope, lighting, mechanical, control systems, water heating, renewable, and High Performance/Code Baseline)?
- ⑥ Are alternatives feasible?
- ⑥ A list developed of potential measures for utility rebates?
- ⑥ Renewable and fuel alternatives investigated?
- ⑥ Work Plan sent to Analyst (copies to owner, utility representative, architect, project manager)?

ELCCA Report

- ⑥ Check format and content for all necessary items.
- ⑥ Check validity of system type comparisons.
- ⑥ Compare report to approved Work Plan.
- ⑥ Check component U-factor calculations.
- ⑥ Check envelope U-factor spreadsheet comparison to code and prescriptives.
- ⑥ Check lighting layouts and calculations.
- ⑥ Compare proposed service water heating to Work Plan checklist.
- ⑥ Compare proposed energy management control system to Work Plan checklist.

Verify Modeling Inputs:

- ⑥ Building orientation
- ⑥ Zone definitions and occupancies
- ⑥ U-factors (compare model inputs to PFEC)
- ⑥ Lighting and equipment power densities
- ⑥ Operating schedules and set points
- ⑥ HVAC parameters (fan cfm, fan KW, input power, zones, capacities, and outside air)
- ⑥ Plant equipment (system type, efficiencies, and part load efficiencies)
- ⑥ Is High Performance Building alternative/code baseline consistent with LEED Protocol?

Check Modeling Outputs:

- ⑥ Loads not met (should be a maximum 5% to 7% of output)
- ⑥ Ventilation air/economizer operation
- ⑥ Simultaneous heating and cooling (how much?)
- ⑥ HVAC system COPs or EERs. Calculate output/input for given time period
- ⑥ Estimated energy usage (EUI comparable to similar building?)
- ⑥ Are hourly and monthly profiles reasonable?

Review Economic Analysis:

- ⑥ System cost information is reasonable (each alternative including HPA)
- ⑥ Maintenance cost data is reasonable
- ⑥ Replacement cost data is reasonable
- ⑥ LCCA-escalation factors are correct
- ⑥ Energy cost matches model results
- ⑥ *Request clarification in a comment letter*

Addendum

- ⑥ Review response to comment letter
- ⑥ Do the changes affect the analysis? If yes, check the revised economic analysis.
- ⑥ Check final Public Facilities Energy Characteristics Form.
- ⑥ Is copy of letter from owner included if lowest LCC option not taken?
- ⑥ *Send approval letter and project summary to owner, cc: E&AS and project manager*

Electric Utilities

Puget Sound Area

City of McCleary
City Hall, P.O. Box 360
100 3rd Street
McCleary, WA 98557
(360) 495-3264

City of Blaine
1200 Yew Street
Blaine, WA 98230-0490
(360) 332-8311
www.ci.blaine.wa.us

City of Fircrest
115 Ramsdell Street
Fircrest, WA 98466-6912
(253) 564-8900

Clallam County PUD
P.O. Box 1090
Port Angeles, WA 98362-0207
(360) 452-9771
http://www.clallampud.net

Lewis County PUD No. 1
P.O. Box 330
321 NW Pacific Avenue
Chehalis, WA 98532-0330
(360) 748-9261
http://www.lcpud.org/

Lakeview Light & Power
P.O. Box 98979
11509 Bridgeport Way S.W.
Tacoma, WA 98498-0979
(253) 584-6060
http://www.lakeviewlight.com

Mason County PUD No. 1
North 21971 Highway 101
Shelton, WA 98584-9763
(360) 877-5249
http://www.masonpud1.org/

Orcas Power & Light Co.
P.O. Box 187
Eastsound, WA 98245-0187
(360) 376-3500
http://www.opalco.com/

Seattle City Light
1015 Third Avenue
Seattle, WA 98104-1198
(206) 684-3000
http://www.ci.seattle.wa.us/light/

Snohomish County PUD No. 1
P.O. Box 1107
2320 California Street
Everett, WA 98206-1107
(425) 783-1000
http://www.snopud.com/

Tacoma Public Utilities/
Tacoma Power
P.O. Box 11007
Tacoma, WA 98411 (253) 502-8377
www.ci.tacoma.wa.us/power/

Tanner Electric Cooperative
P.O. Box 1426
45710 S.E. North Bend Way
North Bend, WA 98045-1426
(425) 888-0623

Puget Sound Area

City of Sumas
P.O. Box 9
433 Cherry Street
Sumas, WA 98295-0009
(360) 988-5711
http://www.cityofsumas.homestead.com/utilityrateinfo.html

Ohop Mutual Light Company
34014 Mountain Highway East
Eatonville, WA 98328
(253) 847-4364

Town of Eatonville
P.O. Box 309
210 Center Street West
Eatonville, WA 98328-0309
(360) 832-3361

City of Centralia (City Light)
1401 W. Mellen St.
Centralia, WA 98531-5044
(360) 330-7512
www.centralia.com/cityhall.

Mason County PUD No. 3
P.O. Box 2148
Shelton, WA 98584-0490
(360) 426-8255
http://www.masonpud3.org/

Town of Steilacoom
1030 Roe Street
Steilacoom, WA 98388-1327
(253) 581-1912
http://www.townofsteilacoom.com/town_offices/public_works.htm

Grays Harbor County PUD No.1
P.O. Box 480
2720 Sumner Avenue
Aberdeen, WA 98520-0109
(360) 532-4220
http://www.ghpud.org/

Peninsula Light Company, Inc.
P.O. Box 78
13315 Goodnough Drive N.W.
Gig Harbor, WA 98335-0078
(253) 857-5950
http://www.penlight.org/

Elmhurst Mutual Power & Light
120 South 132nd Street
Tacoma, WA 98444-4899
(253) 531-4646
http://www.elmhurstmutual.org

Port Angeles City Light
P.O. Box 1150
321 E. 5th
Port Angeles, WA 98362-0217
(360) 457-0411
https://www.cityofpa.us/utilities.htm

Lower Columbia Area

Clark Public Utilities
P.O. Box 8900
Vancouver, WA 98668 (360) 992-3000
www.clarkpublicutilities.com

Kilicitat County PUD
1313 South Columbus
Goldendale, WA 98620
(509) 773-5891
http://www.klickpud.com

Wahkiakum County PUD
P.O. Box 248
45 River Street
Cathlamet, WA 98612
(360) 795-3266

Cowlitz County PUD
960 Commerce Avenue
P.O. Box 3007
Longview, WA 98632-0307
(360) 423-2210
http://www.cowlitzpud.org/

Skamania County PUD
P.O. Box 500
Carson, WA 98610 (509) 427-5126
http://www.skamaniapud.com

Snake River Area

Benton County PUD
P.O. Box 6270
524 South Auburn Street
Kennewick, WA 99336
(509) 582-2175
http://www.bentonpud.org/

City of Richland Energy Resources Department
505 Swift Blvd.
Richland, WA 99352
(509) 942-7390
http://www.ci.richland.wa.us/index.aspx?nid=98

Franklin County PUD
P.O. Box 2407
Pasco, WA 99302 (509) 547-5591
http://www.franklinpud.com/index.php

Benton Rural Electric Association
P.O. Box 1150
402 7th Street
Prosser, WA 99350
(509) 786-2913
http://www.bentonrea.org/

Columbia Rural Electric Assoc.
P.O. Box 46
115 East Main Street
Dayton, WA 99328
(509) 382-2578
http://www.columbiarea.com/

Upper Columbia Area

Big Bend Electric Coop., Inc.
P.O. Box 348
Ritzville, WA 99169
(509) 659-1700
http://www.bbec.org/

Ferry County PUD No. 1
P.O. Box 1039
686 S. Clark Republic,
WA 99166 (509) 775-3325
http://www.fcpud.com/

Lincoln Electric Cooperative, Inc.
P.O. Box 289
Davenport, WA 99122
(509) 725-1141

Chelan County PUD
P.O. Box 1231
Wenatchee, WA 98807
(509) 663-8121
http://www.chelanpud.org/

Grant County PUD
P.O. Box 878
30 "C" Street SW
Ephrata, WA 98823
(509) 754-0500
http://www.gcpud.org/

Okanogan County Electric Coop.
P.O. Box 69
265 Riverside
Winthrop, WA 98862
(509) 996-2228

City of Cheney
112 Anderson Road
Cheney, WA 99004-1870
(509) 498-9249
http://www.cityofcheney.org/index.php?section=util-services

Inland Power & Light Company
320 East Second Avenue
Spokane, WA 99202
(509) 747-7151
http://www.inlandpower.com/

Okanogan PUD
1331 North 2nd Ave.
P.O. Box 912
Okanogan, WA 98840
(509)476-3310
http://www.okanoganpud.org/

City of Ellensburg
420 N. Pearl Street Ellensburg, WA 98926-3112 (509) 962-7224
http://www.ci.ellensburg.wa.us/utilities/energyserv.cfm

Kittitas County PUD No. 1
1400 East Vantage Highway
Ellensburg, WA 98926-3112
(509) 925-3164

Pend Oreille County PUD No. 1
P.O. Box 190
Newport, WA 99156
(509) 447-3137
http://www.popud.com

Vera Water & Power
P.O. Box 630
601 North Evergreen Road
Veradale, WA 99037 (509) 924-3800
www.verawaterandpower.com

Investor-Owned Utilities

Avista Utilities
P.O. Box 3727
1411 E. Mission St.
Spokane, WA 99220
1-800-227-9187
http://www.avistautilities.com

Pacific Power
825 NE Multnomah
Portland, OR 97232
1-888-221-7070
http://www.pacificpower.net

Puget Sound Energy
P.O. Box 97034
10885 NE 4th Street
Bellevue, WA 98009-9734
(425) 452-1234
http://www.pse.com/

Bonneville Power Administration Area

http://www.bpa.gov

Bonneville Power Administration
P.O. Box 3621
905 N.E. 11th Avenue
Portland, OR 97208-3621
(503) 230-3000

Seattle
909 First Ave.
Ste 380
Seattle, WA 98104-3636
(206) 220-6759

Walla Walla Region
6 W Rose St. Suite 400
Walla Walla, WA 99362
(509) 527-6241

Olympia Region
5240 Trosper Rd. SW
Olympia, WA 98512-5623
(360)704-1601

Snohomish Region
914 Ave. D
Snohomish, WA 98290
(360)568-4962

Richland
Kootenai Bldg., Room 215
North Power Plant Loop
P.O. Box 968
Richland, WA 99352
(509) 372-5771

Spokane Region
2410 E. Hawthorne Rd.
Mead, WA 99021
(509) 358-7376

Natural Gas Companies

Avista Utilities
P.O. Box 3727
1411 E. Mission St.
Spokane, WA 99220
1-800-227-9187
http://www.avistautilities.com

City of Enumclaw
1309 Myrtle Ave
Enumclaw, WA 98022
(360) 825-3593
http://www.ci.ellensburg.wa.us/index.aspx?NID=116

Puget Sound Energy
P.O. Box 97034
Bellevue, WA 98009-9734
(425) 452-1234
http://www.pse.com/

Cascade Natural Gas Company
222 Fairview Avenue N.
Seattle, WA 98109
(206) 624-3900
http://www.cngc.com/

Northwest Natural Gas Company
Vancouver Office
1400 Columbia Street
Vancouver, WA 98660
(360) 693-2511
https://www.nwnatural.com

Support Services

City of Buckley
PO Box D
Buckley, WA 98321
(360) 829-1921

Energy Ideas Clearinghouse
Toll-free hotline:
1-800-872-3568
Fax: 1-800-872-3882
925 Plum Street, Bldg. 4
Olympia, WA 98504
Electronic Bulletin Board
1-800-762-3319
http://www.energyideas.org/

Lighting Design Lab
400 East Pine Street, Suite 100
Seattle, WA 98122
(206) 325-9711 or
1-800-354-3864
http://lightingdesignlab.com/

City of Ellensburg
420 North Pearl Street
Ellensburg, WA 98926
(509) 962-7224
http://www.ci.ellensburg.wa.us/index.aspx?NID=117