ENERGY LIFE-CYCLE COST ANALYSIS

GUIDELINES FOR PUBLIC AGENCIES IN WASHINGTON STATE

March 1, 2023

WASHINGTON STATE DEPARTMENT OF ENTERPRISE SERVICES

DES.WA.GOV/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.

DES Contacts

For questions or assistance in preparing an ELCCA, contact:

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Energy Life-Cycle Cost Analysis guidelines and forms can be obtained online at des.wa.gov/ELCCA.

To request communication services (written information in other languages, or other services) or accommodations, please call (360) 407-2224 or 711 (Telephone Relay Service), or email EnergyTeam@des.wa.gov.

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I. 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 aiding in the development and review of ELCCA reports.

Energy Life Cycle Cost Analysis

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, the cost of owning and operating a facility over its useful life, and the social cost of carbon associated with greenhouse gas emissions. 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.

Per RCW 39.35.020 it is the public policy of this state to ensure that energy conservation practices, greenhouse gas reduction practices, and renewable energy systems are employed in the design of major publicly owned or leased facilities. ELCCAs should compare three or more system alternatives, including the use of renewable energy or combined heat and power systems, and at least one all-electric energy system.

In 2022, the legislation acknowledged that publicly owned or leased facilities significantly impact our states emission of greenhouse gases.

The legislature added language requiring that ELCCAs analyze the use of an all-electric energy system in lieu of a minimum U.S Building Green Building Council's LEED NC Silver Standard. The economic analysis should include the social cost of carbon (cost of greenhouse gas emissions) associated with greenhouse gas emissions from energy consumption.

To meet the legislative intent for energy efficiency and renewables, DES requires that at least one alternative design including renewables or combined heat and power be analyzed. Check the ELCCA website | des.wa.gov 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 or combined heat and power, and all-electric resources when feasible and cost-effective

Review and Approval of ELCCAs

DES will review ELCCAs for any public entity. 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 contact the DES Energy Program.

DES 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 require review by DES. See the latest Washington Sustainable Schools Protocol (WSSP) for more information regarding ELCCAs for public schools.

How Have These Guidelines Changed?

Following are changes from the previous version of these guidelines (December 2016):

- → Inclusion of costs associated with greenhouse gas emission (social cost of carbon) in economic analysis
- → Requirement to analyze an all-electric system alternative
- → Removal of requirement for system alternative to comply with U.S Building Green Building Council's LEED NC Silver Standard
- → Removal of requirement to analyze a "high performance Building" in favor of letting design engineers decide what the most cost-effective alternates should be.
- → Inclusion of latest RCW/WAC changes
- → Glossary and Appendices updated.

→ Change in Building modeling software section to a set of requirements instead of list of approved software.

II. 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).

   <u>Example</u>: 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.

   <u>Example</u>: 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 Section V. Preparing the Report) 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 ELCCA Integration with Building Design Phases 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 using the results of the ELCCA to inform early design decisions. The ELCCA Analyst (the "Analyst") is responsible for preparing and submitting the ELCCA Work Plan, the ELCCA Study Matrix, and the ELCCA Report 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. Both the Work Plan and ELCCA Report should be sent to the utilities at the same time as submission to the reviewer, so that they can reference them regarding potential incentive payment.

ELCCA Process/Submittals

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

1. ELCCA Work Plan and Washington Sustainable Schools Protocol (WSSP) Checklist (Figure 3.1 ELCCA Work Plan) if applicable.
2. ELCCAT Preliminary Results (Figure 4.1 ELCCAT | ofm.wa.gov) This can be submitted concurrently with or as part of the ELCCA Report (3.)
3. ELCCA Report (See Section V. Preparing the Report)

The schedule for submittals is indicated below.

1) ELCCA WORK PLAN AND WSSP CHECKLIST (SEE SECTION III. THE WORK PLAN)

Schedule: Prepared by the Analyst and submitted to the Reviewer early in 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, (see Figure 3.1 ELCCA 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 envelope and lighting strategies that will be analyzed to help achieve energy goals and the specific Renewable and All Electric Alternatives to be considered. A copy of the WSSP checklist must also be submitted along with work plans for K12 projects. Elements identified in the checklist should be reflected in the Work Plan as a potential means of achieving the Agencies energy goal.

2) ELCCAT PRELIMINARY RESULTS (SEE SECTION IV. ENERGY USE SIMULATION AND ECONOMIC ANALYSIS)

*Schedule: Prepared by the Analyst and submitted to the Project Team (**not the Reviewer**) at the beginning of Design Development*

The Preliminary results, see Figure 4.1 ELCCAT | ofm.wa.gov, presents early results of the comparison of multiple HVAC system designs based on preliminary building geometry using the Office of Financial Management (OFM) Evaluation Life Cycle Cost Analysis Tool (ELCCAT). The intent of the modeling at this stage is to inform early design decisions such as siting and orientation, geometry, massing, passive strategies, glazing size and location, shading and daylighting strategies. Alternatives undergo computer simulation to arrive at energy costs. The ELCCAT is used to calculate Life Cycle Costs and Net Present Savings for the different alternative designs.

3) THE ELCCA REPORT (SEE SECTION V. PREPARING THE REPORT)

Schedule: Prepared by the Analyst and submitted to the Reviewer during construction documents.

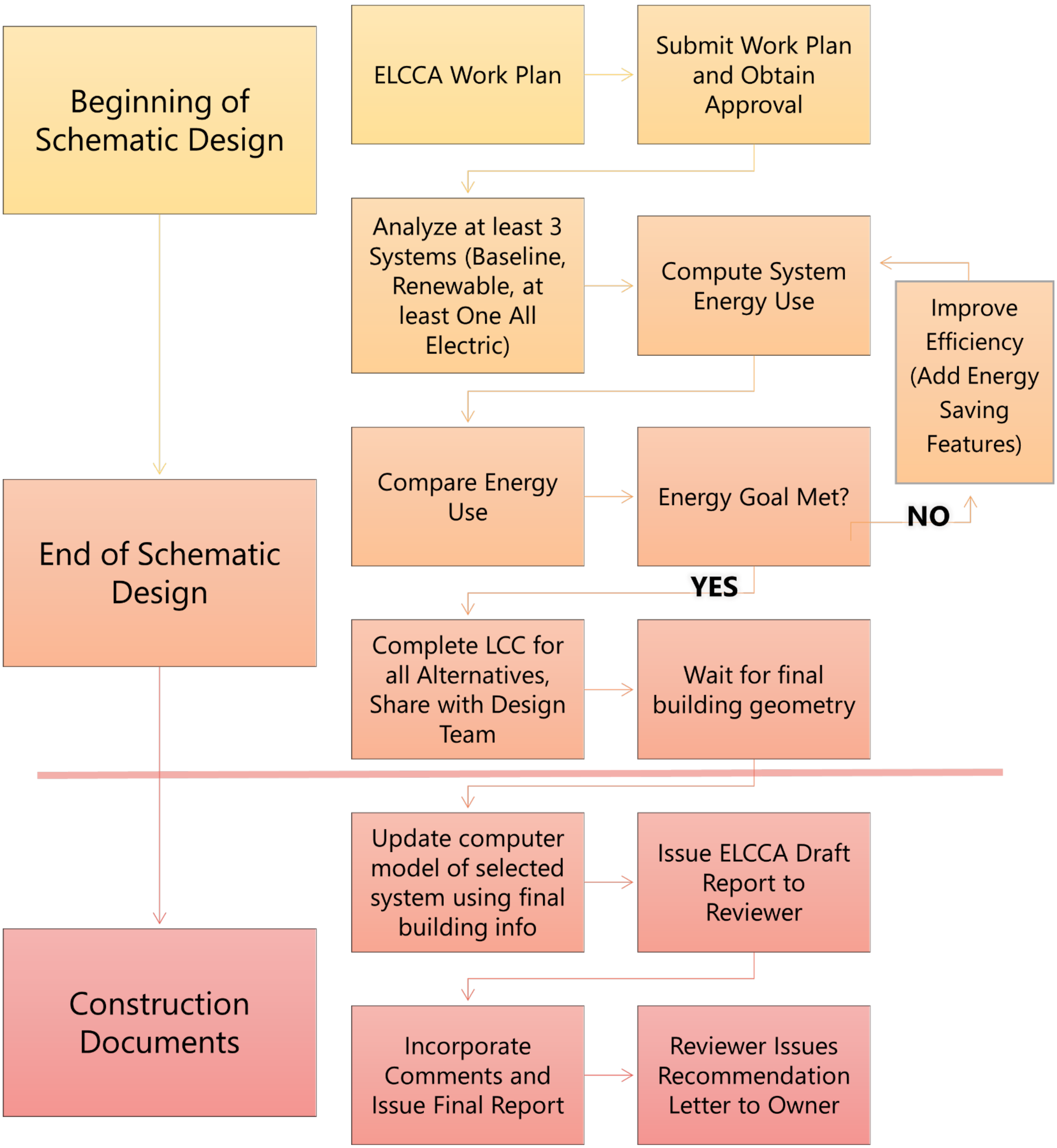
The ELCCA Analyst must submit a report consistent with the analysis guidelines (see Section IV: Energy Use Simulation and Economic Analysis) and the report guidelines (see Section V: Preparing the Report). The computer model for the baseline and selected system is updated to reflect the final building design. This allows for the final performance and savings estimates to be established.

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 by greater than 10%, 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.

Figure 2.1 ELCCA Integration with Building Design Phases

	A/E Selection	Schematic Design	Design Development	VE Review	Construction Documents
Owner	Select A/E and VE Team	Determine whether ELCCA is required; select Analyst Participate in Work Plan development Review ELCCA Preliminary Results		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 required Participate in Work Plan development Review ELCCA Preliminary Results		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 Preliminary Results		Present ELCCA Preliminary Results to VE team	Prepare & submit ELCCA Report reflecting final building configuration Address comments & make corrections to report
ELCCA Reviewer		Review & approve Work Plan			Review Report & return comments Recommend ELCCA to owner
VE Team				Consider Life Cycle Costs in VE report	

Figure 2.2 ELCCA Process Flowchart



III. THE WORK PLAN

What is considered in the ELCCA study is as important as how the study is done. 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. 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 3.1 ELCCA Work Plan. This form is also available in PDF format on our website: ELCCA Work Pan Form | des.wa.gov. The following sections provide additional guidance in developing the Work Plan.

STATEMENT OF ENERGY DESIGN INTENT

In consultation with the Owner and Design team, the desired energy performance of the building in terms of percentage improvement over the base model and in terms of Energy Use Index (EUI) is stated. The intent is to provide a means to track progress in meeting the organizations energy and greenhouse gas reduction goals.

BUILDING ENVELOPE

Provide details of the planned envelope components and describe any better than code envelope features that will be considered

LIGHTING SYSTEMS

Provide details by functional area of the lighting components that are planned and describe any better than code lighting features that will be considered.

AIR LEAKAGE

Provide design and construction strategies to ensure a continuous air barrier and state the infiltration rate assumed for the analysis.

MECHANICAL SYSTEMS

A baseline, code compliant; and two alternative mechanical systems that include renewable/combined heat and power and at least one all electric, at a minimum shall be compared and analyzed. In compliance with the carbon reduction strategies set forth in RCW 70.235.050. DES encourages inclusion of a net-zero-energy alternate if the analyst is needing more ideas for alternates.

BASELINE CODE COMPLIANT SYSTEM

The baseline model will be developed and for the purposes of the analysis is defined as the lowest capital cost building that meets state building and energy codes.

RENEWABLE ENERGY SYSTEM

One of the analyzed systems must include a renewable energy source or combined heat and power. Table 3.1 presents acceptable options; others may be proposed by the Analyst.

Table 3.1 Renewable Examples

Renewable Resource	**Acceptable System Options**
Waste Heat Recovery	Exhaust gas / Ventilation air heat exchanger not already required by code
Solar Energy	Photovoltaic cells or solar water heater Solar thermal cells or panels for space heating and domestic hot water (DHW)
Wind	Wind generator
Biofuel	Wood chips in heating boiler
Geothermal	Ground source heat pumps

ALL ELECTRIC ALTERNATIVE

The analyst must include at least one alternative that is all electric regarding mechanical, and domestic water systems for the HVAC and domestic water systems of the building. This does not prohibit combustion equipment for process or learning use.

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 contrasts with 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 renewable alternative and can be used on any alternative. Information on using building simulation software to calculate life-cycle costs of integrated energy systems can be found in Section IV: Energy Use Simulation and Economic Analysis.

OTHER ENERGY SYSTEMS

Building projects may involve energy systems not specifically described previously. Examples may include:

- → Cogeneration Equipment
- → Emergency Power Systems
- → Combined heat and 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. The Reviewer will communicate approval of the Work Plan via email. 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 analysis and report.

Figure 3.1 ELCCA Work Plan

IV. 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 estimate and document the total cost of ownership of each system over its life.

The annual cost of energy use is calculated through an hourly building simulation model and the ELCCAT tool, which calculates 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). ELCCA Analyst should use the WSEC that is in affect at the time of the analysis.
- → Each simulation shall be performed by a computer program that can simulate the energy performance of building systems on an hourly basis.
- → The annual cost of energy for 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. Selected computer software programs should be ASHRAE Standard 140 compliant. These programs have been extensively tested and widely accepted in the industry. Qualified Software for Calculating Commercial Building Tax Deductions | Department of Energy

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 Mechanical Systems: ELCCA guidelines require that a minimum of three systems be analyzed: a baseline code compliant model, a renewable energy systems model and at least one all electric alternative.

Baseline Model: Defined as the lowest capital cost building that meets state building and energy codes.

Renewable or combined heat and power Energy System: One renewable energy system alternative is to be analyzed. Table 3.1 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 the annual cost of energy 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 50-year life-cycle cost.

All electric: This alternative must have all mechanical and domestic water equipment be utilizing electric power and no combustion equipment for space heating, ventilation, or domestic water systems.

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 may be at least partially offset by downsized chillers, cooling coils, chilled water piping, pumps, ductwork, and fans.

Integrated Design Alternatives: The Analyst should examine integrated design alternatives by using the computer energy simulation to calculate energy usage for all interactive alternatives.

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 or if requested by the Owner, alternatives must be analyzed.

Input Assumptions

Envelope U-factors: Calculate effective U-factors for all envelope components to comply with the latest version of the *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.

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 default U-factors and shading coefficients listed in the WSEC.

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

Lighting: Input the lighting power density for each HVAC zone of the model. Corridors may have less density, while drafting rooms may have more. Applicable building code default value for lighting power densities can also be used. Include off-hour activities and custodial work in the hours of operation.

System and occupancy schedules: Use the actual occupancy schedules if known or the default occupancy schedules found in the WSEC.

Occupancy Densities, Receptacle Power Densities, and Hot Water Usage: Use the actual building data if available or the default values found in the WSEC.

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 "unmet load hours" 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.

Economic Analysis

An excel spreadsheet titled "Evaluation Life Cycle Cost Analysis Tool" (ELCCAT) is available for the economic analysis portion of the report. The spreadsheet is available electronically at the following link: ELCCAT | ofm.wa.gov and a sample input and results report is provided in Figure 4.1. The information needed to complete the spreadsheet includes:

- Construction costs (include utility incentive where applicable)
- Equipment useful life
- Annual maintenance costs
- Annual Energy usage for each fuel type
- Fuel costs

The spreadsheet takes this input and uses standardized key assumptions, such as building life, discount rate, and fuel escalation rates to calculate Life Cycle Cost and Net Present Savings. An additional column accounts for Societal Cost in the Net Present Savings. The spreadsheet applies a consistent methodology in calculating how often components need to be replaced and determines residual value at the end of the study life. The hope is that by standardizing the life cycle cost analysis methodology more consistent and comparable results will be achieved.

FIGURE 4.1 ELCCAT | OFM.WA.GOV

ECONOMIC BUILDING LIFE/EQUIPMENT USEFUL LIFE

A default of 50 years has been set as the economic life. Equipment useful life is presented in Table 4.1 Equipment Service Life. 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 COSTS

Provide an itemized system cost estimate (breakdown) for each alternative, analyzed by major equipment items. Lump sum costs to include labor, materials, overhead and profit, and taxes.

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 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)

Maintenance costs should be presented as a lump sum per major equipment item.

Table 4.1 Equipment Service Life

Energy Conservation Measure/ Equipment	Median Life (yrs.)	Energy Conservation Measure/ Equipment	Median Life (yrs.)
Air Conditioners		**Coils**	
Window unit	10	DX, water, or steam	20
Residential single or split package	15	Electric	15
Commercial through-the-wall	15	**Heat Exchangers**	
Water-cooled package	15	Shell and tube	24
Single zone roof top	15	**Compressors**	20
Multi zone rooftop	15	**Chillers**	
Heat Pumps		Absorption	23
Commercial air to air	15	Centrifugal	23
Commercial water to air	19	Reciprocating	20
Residential air to air	15	**Cooling Towers**	
Boilers, hot water (steam)		Ceramic or FRP	34
Steel water tube	24 (30)	Galvanized metal	20
Steel fire-tube	25 (25)	Wood	20
Cast iron	35 (30)	**Condensers**	
Electric	15	Air-cooled	20
Burners	21	Evaporative	20
Furnaces		**Insulation**	
Gas or oil-fired	18	Molded	20
Unit Heaters		Blanket	24
Gas or electric	13	**Pumps**	
Hot water or steam	20	Base mounted	20
Radiant Heaters		Condensate	15
Electric or gas	10	Pipe mounted	10
Hot water or steam	25	Sump and well	10
Air Terminals		**Reciprocating Engines**	20
Diffuser, grilles, and registers	27	**Steam turbines**	30
Induction and fan-coil units	20	**Electric Motors**	18

VAV and double-duct boxes	20	**Motor starters**	17
Air Washers	17	**Electric transformers**	30
Ductwork	30	**Controls**	
Dampers	20	Electric	16
Fans		Electronic	15
Centrifugal	25	Pneumatic	20
Axial	20	**Valve actuators**	
Propeller	15	Hydraulic	15
Ventilating, roof mounted	20	Pneumatic	20
		Self-contained	10

Adapted from: ASHRAE Handbook 2011 Applications, Page 37.3, Table 4

V. PREPARING THE REPORT

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

→ Electronic PDF copy is preferred, though with reviewer approval an 8.5" x 11" paper copy may be accepted.

→ 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

A) TITLE PAGE

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

B) 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

C) 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.

D) 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.

1) Complete the Public Facility Energy Characteristics (PFEC) form (Figure 5.1, Public Facilities Energy Checklist Summary | des.wa.gov) with information for each of the recommended energy systems. If the project includes new construction and renovation, provide a separate form for each.
2) For the recommended systems, provide estimates of the building's annual energy costs, maintenance costs (use R.S. *MEANS Facilities Maintenance and Repair Cost Data* and/or *The Whitestone Building Maintenance and Repair Cost Reference*) and social cost of greenhouse gas emissions costs (use ELCCAT tool greenhouse gas emissions section to calculate). Break the costs into two categories: dollars per year ($/yr) and dollars per square foot per year ($/sf/yr.).
3) 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.
4) Include the ELCCA Results Table output from the ELCCAT spreadsheet.
5) include a table that shows the total lifecycle costs (from above), the total cost of greenhouse gas emissions (from the ELCCAT tool), and a grand total cost of the two added for each alternate.

6) Provide a project timeline through construction.
7) Briefly describe technical or financial assistance to improve the project's energy efficiency that is available from natural gas and electric utilities.

E) 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

F) 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.

Baseline Building Description

Summarize the Baseline building parameters and establish a baseline building cost opinion. A baseline model will be developed that reflects the lowest first cost building model that meets the applicable building code and owners minimum program and performance requirements.

Enter baseline data into the ELCCAT spreadsheet. Inputs on this and all subsequent ELCCA Spreadsheets in report should have sufficient supporting information to allow reader to follow the logic of each entry. Each entry for first cost, maintenance, and replacement costs should be supported by an estimate sheet or software output showing how these costs and/or intervals are arrived at. Energy Costs should be backed up by load summary from the energy modeling software clearly labeled by alternative.

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.

G) BUILDING ENVELOPE

→ Describe the recommended envelope components (roof, wall, glazing, doors, floors, etc.), indicating materials, insulation values, and variations from baseline levels.

→ Describe the baseline envelope, and any other envelope alternatives analyzed.

→ Show typical sections and U-factor calculations for all construction types being recommended, (Figure 5.1 provides 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.

H) LIGHTING SYSTEMS

→ Describe the recommended system for each functional area of the building.

→ 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.

I) 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. Also show the ELCCAT calculated cost of greenhouse gas emissions for each alternative.

J) 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.

K) 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.

L) DOMESTIC HOT WATER (DHW)

Describe the recommended DHW system. If alternatives are analyzed, provide a description, predicted energy use and cost estimates (annual energy cost, maintenance cost, material & labor costs).

M) OTHER ENERGY SYSTEMS

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

N) APPENDICES

Include the following, at a minimum, clearly identified:

1) Approved Work Plan
2) Computer input and output summary reports for the Energy Cost Budget model and for each alternative
3) Scaled floor plan showing the HVAC zones as modeled
4) Site plan including orientation

5) Letter of acknowledgement from Owner (if an alternative is recommended that varies from the lowest life-cycle cost by greater than 20%)

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.
- → **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 an email to the Analyst listing any questions or concerns about the report. The Analyst will have up to 7 days to respond to those questions or concerns in an email. This process may then be repeated until all the Reviewer’s concerns have been addressed (See Appendix C: Review Process Checklist).

FIGURE 5.1 PUBLIC FACILITIES ENERGY CHARACTERISTICS FORM

APPENDIX A: GLOSSARY OF TERMS

All Electric Building: A Building that contains no combustion equipment for the purposes of the systems analyzed in the ELCCA. The building space heat, ventilation, and domestic water systems shall include only electricity as an energy source.

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: Is a calendar year upon which the analysis is based.

Baseline Model: Is a defined as the lowest capital cost building that meets state building and energy codes.

Building Automation System: Is 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: Is 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): Is 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.

Daylighting: 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 recycling. *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.

Independent Commissioning Agent: A commissioning agent that works directly for the building owner and is a subcontractor to neither 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: Is a 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.

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 Software Tools | Department of Energy.

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.

Net Zero Energy Building: An energy-efficient building where the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

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 if 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 Definitions.)

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.

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)

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.

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

WSSP (Washington Sustainable Schools Protocol): Standard developed to help school districts achieve high performance.

APPENDIX B: ENABLING LEGISLATION AND ADMINISTRATIVE CODE

Revised Codes of Washington (RCW)

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 and emission of greenhouse gases from the buildings sector;

(2) That energy conservation practices including energy management systems, combined heat and power systems, 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 beneficial effect of the electric output from combined heat and power systems includes both energy and capacity value;

(4) That the cost of the energy consumed by such facilities, and the greenhouse gas emissions associated with that energy consumption, over the life of the facilities shall be considered in addition to the initial cost of constructing such facilities;

(5) 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, including the costs associated with greenhouse gas emissions from energy consumption; and

(6) That the use of energy systems in these facilities which utilize combined heat and power or renewable resources such as solar energy, wood or wood waste, or other nonconventional fuels, and which incorporate energy management systems, shall be considered in the design of all publicly owned or leased facilities.

[2022 c 178 § 1; 2015 3rd sp.s. c 19 § 2; 2001 c 214 § 15; 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 ensure that energy conservation practices, greenhouse gas emissions reduction practices, and renewable energy systems are employed in the design of major publicly owned or leased facilities and that the use of all-electric energy systems and at least one renewable energy or combined heat and power system is considered. To this end the legislature authorizes and directs that public agencies analyze the cost of energy consumption of each major facility and each critical governmental facility to be planned and constructed or renovated after September 8, 1975.

[2022 c 178 § 2; 2015 3rd sp.s. c 19 § 3; 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) " Combined heat and power " means the sequential generation of electricity and useful thermal energy from a common fuel source, under normal operating conditions, the facility has a useful thermal energy output of no less than thirty-three percent of the total energy output.

2) "Critical governmental facility" means a building or district energy system owned by the state or a political subdivision of the state that is expected to:

    (a) Be continuously occupied;

    (b) Maintain operations for at least six thousand hours each year;

    (c) Have a peak electricity demand exceeding five hundred kilowatts; and

    (d) Serve a critical public health or public safety function during a natural disaster or other emergency that may result in a widespread power outage, including a:

        i. Command and control center;

        ii. Shelter;

        iii. Prison or jail;

        iv. Police or fire station;

        v. Communications or data center;

        vi. Water or wastewater treatment facility;

        vii. Hazardous waste storage facility;

        viii. Biological research facility;

        ix. Hospital; or

i. Food preparation or food storage facility.

3) "Department" means the state department of enterprise services.

4) "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.

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

6) "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.

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

8) (a) "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 or a critical governmental facility by its occupants, equipment, and components, and the external energy load imposed on a major facility or a critical governmental facility by the climatic conditions of its location. An energy-consumption analysis of the operation of energy systems of a major facility or a critical governmental facility shall include, but not be limited to, the following elements:

   a. (i) The comparison of three or more system alternatives, at least one of which shall include renewable energy systems, and one of which shall include all-electric energy systems;

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

   c. (iii) 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.

   d. (iv) The identification and analysis of critical loads for each energy system; and

e. (v) For a critical governmental facility, a combined heat and power system feasibility assessment, including but not limited to an evaluation of: (A) Whether equipping the facility with a combined heat and power system would result in expected energy savings in excess of the expected costs of purchasing, operating, and maintaining the system over a fifteen-year period; and (B) the cost of integrating the variability of combined heat and power resources.

8) (b) 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.

9) "Greenhouse gas" has the same meaning as provided in RCW 70A.45.010.

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

11) "Life-cycle cost" means the initial cost and cost of operation of a major facility or a critical governmental 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.

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

a. The coordination and positioning of a major facility or a critical governmental facility on its physical site;

b. The amount and type of fenestration employed in a major facility or a critical governmental facility;

c. The amount of insulation incorporated into the design of a major facility or a critical governmental facility;

d. The variable occupancy and operating conditions of a major facility or a critical governmental facility; and

e. An energy-consumption analysis of a major facility or a critical governmental facility.

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

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

15) "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.

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

17) "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.

[2022 c 178 § 3; 2015 3rd sp.s. c 19 § 4. Prior: 2011 1st sp.s. c 43 § 247; 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 or a critical governmental 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 facility.

Nothing in this section prohibits the construction or renovation of major facilities or critical governmental facilities that utilize renewable energy or combined heat and power systems.

[2015 3rd sp.s. c 19 § 5; 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 energy management systems, all-electric energy systems, renewable energy systems, and combined heat and power 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.

[2022 c 178 § 4; 2001 c 214 § 17; 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 enterprise services account. 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.

[2015 c 225 § 45; 2001 c 292 § 1; 1996 c 186 § 404; 1991 c 201 § 16.]

Washington Administrative Code

WAC 392-343-075 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 in accordance with chapter 39.35 RCW, and approved by the school district board of directors. One copy of the executive summary of said approved energy conservation report shall be filed with the office of the superintendent of public instruction. The amount of state funding assistance for which a district is eligible for the preparation of the energy conservation report shall be the state funding assistance percentage multiplied by the fee charged, up to a maximum of the state funding assistance percentage multiplied by ten thousand dollars.

[Statutory Authority: RCW 28A.525.020. WSR 21-13-129, § 392-343-075, filed 6/22/21, effective 7/23/21; WSR 10-09-008, § 392-343-075, filed 4/8/10, effective 5/9/10; WSR 06-16-032, recodified as § 392-343-075, filed 7/25/06, effective 8/25/06; WSR 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. WSR 92-24-027, § 180-27-075, filed 11/24/92, effective 12/25/92. Statutory Authority: RCW 28A.47.830. WSR 83-21-066 (Order 11-83), § 180-27-075, filed 10/17/83.]

APPENDIX C: 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**: ____________

WORK PLAN

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

ELCCA REPORT

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

- ❑ Compare proposed energy management control system to Work Plan checklist.

Verify Modeling Inputs:

- ❑ Building orientation
- ❑ Zone definitions and occupancies
- ❑ U-factors (compare model inputs to PFEC)
- ❑ Lighting and equipment power densities
- ❑ Operating schedules and set points
- ❑ HVAC parameters (fan cfm, fan KW, input power, zones, capacities, and outside air)
- ❑ Plant equipment (system type, efficiencies, and part load efficiencies)

Check Modeling Outputs:

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

Review Economic Analysis:

- ❑ System cost information is reasonable (each alternative including HPA)
- ❑ Maintenance cost data is reasonable
- ❑ Replacement cost data is reasonable
- ❑ Energy cost matches model results

FIGURES/FORMS

TABLES