



LIFE CYCLE COST ANALYSIS GUIDELINES 2002

Department of Natural Resources

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INTRODUCTION

The purpose of the Life Cycle Cost Analysis (LCCA) Guidelines is to assist architects and engineers in completing life cycle cost analysis reports required by the Code of Iowa for publicly owned facilities. The LCCA Guidelines provide a methodology intended to standardize analysis reporting and to facilitate a timely and accurate technical review.

Since public facility capital improvement and operating funds are limited, life cycle costing is intended to optimize building efficiency by requiring construction to the lowest life cycle cost. Life cycle cost analysis is an economic analysis method of project alternative evaluation in which all ownership costs are considered. LCCA is particularly suited for evaluation of design alternatives that have different levels of efficiency, but that also have different initial investment costs, different operation, maintenance, and repair costs, and different service lives. LCCA is a method that can be applied to any capital investment decision in which higher initial costs are traded for reduced future operating costs. The ultimate purpose of life cycle costing and of these guidelines is to provide information for decision-making that more accurately portrays the cost of a project alternative than first cost alone (refer to Code of Iowa Section 72.5).

When Required

The Code of Iowa defines when Life Cycle Cost Analysis is required when it states "... a public agency responsible for the construction or renovation of a facility shall... include as a design criterion the requirement that a life cycle cost analysis be conducted for the facility." (470.2) Pertinent Code (470.1) definitions are as follows:

- "'Facility' means a building having twenty thousand square feet or more of usable floor space that is heated or cooled by a mechanical or electrical system or any building, system, or physical operation which consumes more than forty thousand British thermal units (BTUs) per square foot per year."
- "'Renovation' means a project where additions or alterations exceed fifty percent of the value of a facility and will affect an energy system."
- "Energy system" includes, but is not limited to, equipment or measures used to heat or cool the facility, heat water, or generate electricity...

Compliance with Iowa Code is the responsibility of the public agency.

Timing of a Life-Cycle Cost Analysis

In order for life cycle cost analyses to be used as a guide to making building design decisions, the LCCA must be completed before system selection decisions and approved before construction. Iowa Code recognizes the need for LCCAs to be done early in the design process when it states that a "life cycle cost analysis shall be approved... before contracts for the construction or renovation are let." (470.4) (exceptions defined in 470.5)

Review and Approval Procedure

The public agency responsible for the new construction or renovation is to submit the life cycle cost analysis to the Iowa Department of Public Safety for review. (Contact the Department of Public Safety, Fire Marshal Division, Building Code Bureau for submission instructions at 515/281-5821). The Building Code Bureau will forward one copy of the LCCA report to the Iowa Department of Natural Resources' (Department) Energy Bureau for technical review and approval. The purpose of the technical review is to ensure compliance with the Code of Iowa and that cost estimates, assumptions, and conclusions are reasonable and accurate. If there are technical problems or if the Department disagrees with any aspects of the report, the Department will request clarification or revision of the report. The public agency (or an engineer or architect preparing a life cycle cost analysis for a public agency) shall respond in writing to the Department. (470.7)

If the public agency is also a state agency, disagreements between the state agency and the Department must be presented to the Department in writing. Iowa Code directs that this documentation be transmitted by the Department to the Executive Council for resolution. (470.7)

In any case, the life cycle cost analysis process, including submittal and approval shall be completed before the letting of contracts for the construction or renovation of a facility. (470.7)

Upon completion of the Department's review, an approval letter will be sent to the public agency submitting the report. If the life cycle cost analysis report has been prepared by a design professional representing the public agency, the approval letter will be sent to the design professional and copied to the public agency. In any case, the approval letter will be copied to the Building Code Bureau.

Legal Requirements

The purpose of Iowa's life cycle cost law is to discourage construction of public buildings based upon lowest acquisition cost, and instead to require that decisions be based upon life cycle costs to reduce energy consumption, maintenance requirements, and continuing burdens upon taxpayers. (72.5) The life cycle cost requirements apply to all buildings using public funds for renovation or construction. Life cycle cost analyses must conform to the requirements of Iowa Code before a contract is let for an improvement or construction of a public building by the state or an agency of the state. (72.5)

Iowa Code Chapter 470 of the 2001 Code of Iowa includes requirements pertaining to life cycle cost studies. (The text of the applicable laws is provided in the appendix of these guidelines.) The code states that a public agency or a person preparing a life cycle cost analysis for a public agency "shall consider the methods... provided by the department". These guidelines are intended to serve this purpose.

Code of Iowa Section 470.1.5 lists the minimum equipment or measures to be analyzed in a life cycle cost analysis, including:

- (1) the equipment used to heat or cool the facility
- (2) equipment used to heat the water
- (3) on-site electric generating equipment

Section 20 of Chapter 473 of the 2001 Code of Iowa includes the requirement that a school district, community college, area education agency, city, or county “shall design and construct the most energy cost-effective facilities feasible and shall use the financing made available by the department to cover the incremental costs above minimum building code energy efficiency standards of purchasing energy efficient devices and materials unless other lower cost financing is available. (473.20.5)

Therefore, rationale against the installation of high efficiency systems based on higher first cost are not valid since the incremental cost can be financed through the Building Energy Management Programs. Contact the Iowa DNR Energy Bureau at (515) 242-5851 for more information.

ANALYSIS PROCEDURE

The goal of this life cycle cost analysis procedure is to select from a set of alternatives the building design with the lowest life-cycle cost. In each case, the analyst is to consider design alternatives for the domestic hot water system, lighting system, and combinations of building envelope-HVAC (heating, ventilation, and air-conditioning) systems. When applicable, the analyst is to consider design alternatives for on-site electricity generation. Each analysis is to be based on a **25 year study period and shall use U.S. Department of Energy Federal Energy Management Program (FEMP) indices**. In the case of wind turbine electricity generation, refer to the Department's current version of the *Wind Feasibility Study Guidelines* for specific wind turbine-related requirements.

The analysis methodology must first consider the relationship between energy-using systems. When the amount of energy consumed by one system impacts the energy consumed by another, this interaction must be carefully considered in the analysis. The accepted methodology is for the analysis to first evaluate independent systems, followed by those systems that interact. The analysis procedure is as follows:

- 1) Find the life cycle cost of three domestic hot water system alternatives and select the one with the lowest life cycle cost.
- 2) Find the life cycle cost of three lighting system alternatives and select the one with the lowest life cycle cost.
- 3) Use the recommended domestic hot water and lighting systems and find the lowest life cycle cost combination of three building envelopes and three HVAC systems. There will be nine building envelope-HVAC system alternatives to evaluate.

There will be fifteen life cycle cost calculations including one for each of three domestic hot water alternatives, one for each of three lighting alternatives, and one for each of nine building envelope-HVAC system alternatives.

When applicable:

- 4) Use all of the recommended building systems to evaluate three on-site electric generation system alternatives and select the one with the lowest life cycle cost. In the case of wind turbine generation, refer to the Department's current version of the *Wind Feasibility Study Guidelines* for other requirements.

A particularly useful reference for life cycle costing procedures is the *Life-Cycle Costing Manual for the Federal Energy Management Program*, National Institute for Standards and Technology (NIST) Handbook 135, 1995 Edition. This manual can be ordered from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
(800) 553-6847 or
(703) 487-4650

This manual can also be downloaded on the internet at:

<http://www.bfrl.nist.gov/oea/publications/handbooks/135.pdf>

In April of each year NIST also publishes an annual supplement to Handbook 135 titled “Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis”. This supplement includes discount factors to be used in life cycle cost analysis calculations. The analyst should use current discount rates, however, only U.S. Department of Energy (DOE) Federal Energy Management Program (FEMP) rates are to be used (do not use Office of Management and Budget (OMB) rates). Analysts without internet access or analysts unclear on the appropriate rates to use may call Lee Vannoy at (515) 281-6559. The current supplement to Handbook 135 and the current Building Life Cycle Cost computer software (updated annually) can be downloaded from:

<http://www.eren.doe.gov/femp/techassist/softwaretools/softwaretools.html>

The manual and the annual supplement is in Adobe Portable Document Format (PDF) so the Adobe® Acrobat® Reader® software must be used. Acrobat Reader can be downloaded from the internet at:

<http://www.adobe.com/products/acrobat/readmain.html>

STANDARD FORMAT FOR LIFE CYCLE COST REPORTS

The format of Life Cycle Cost Analysis (LCCA) reports are to be similar to the format of these guidelines. Information is to be clearly presented and understandable to all parties in the process (facility, financial, technical). LCCA reports are to be stand-alone documents, meaning that they are to include all information needed for the review, and for future reference.

The order of sections and appendices are:

1. Certification
2. Executive Summary
3. Project Identification
4. Assumptions Form
5. Life-Cycle Cost Analysis
 - A. Domestic Hot Water
 - B. Lighting
 - C. Building Envelope and HVAC System
 - D. On-Site Electric Generation
 - E. Recommended Systems
6. Appendix

Section 1: Certification

The first form required is the Certificate of Responsibility (refer to the following page). The report must be certified by either a registered Architect or a licensed Professional Engineer in Iowa.

Iowa has adopted the codified version of ASHRAE Standard 90.1-1989 as its energy code for commercial buildings, so this is the base case for each alternative studied. The analyst is to answer the question at the bottom of the form to verify that all design options in the report comply with the energy code.

Certificate of Responsibility

Professional Engineer

SEAL	<p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <p>(signature) _____ (date) _____</p> <p>Printed or typed name _____</p> <p>My license renewal date is December 31, _____. Pages or sheets covered by this seal:</p> <p>_____</p> <p>_____</p> <p>_____</p>
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Registered Architect

SEAL	<p>I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and responsible charge. I am a duly registered architect under the laws of the state of Iowa.</p> <p>Printed or typed name _____</p> <p>Signature _____ Date _____</p> <p>Registration Expires _____ Date Issued _____</p> <p>Pages or sheets covered by this seal:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
-------------	---

Do the designs presented in this report meet Iowa energy code requirements as adopted from ASHRAE Standard 90.1?
--

____ Yes ____ No

Section 2: Executive Summary

The Executive Summary is to include an explanation of the purpose of the report, a summary of important findings of the report, a description of important assumptions and special design considerations used in the analysis, and system selection recommendations based on lowest life cycle cost. The Executive Summary must also provide an annual energy budget for the facility based on the assumptions previously documented in Section 3. The Life-Cycle Cost Analysis Summary Form must be provided in the Executive Summary (refer to the next page). The Life-Cycle Cost Analysis Summary Form tabulates the findings of each system alternative evaluated in the report. The LCCA Summary Form also provides the derivation for the annual energy budget for the base case and for the facility alternatives yielding the lowest life cycle cost. The derivation of the annual energy budget should not double count energy consumption data, such as lighting energy that is often also included in HVAC energy consumption calculations.

Life Cycle Cost Analysis Summary

Building Area _____ square feet

System	Description	Option Number	Electricity (kWh)	Natural Gas (Therms)	Annual mmBtu	Annual Energy Cost (\$)	EUI (Btu/sq.ft./year)	Life Cycle Cost (\$)	Initial Cost (\$)
Lighting / Electrical		1							
		2							
		3							
Domestic Hot Water		1							
		2							
		3							
Envelope & HVAC combinations		1A							
		1B							
		1C							
		2A							
		2B							
		2C							
		3A							
		3B							
		3C							
Electricity Generation		1							
		2							
		3							

Notes:

1. Designate each recommended system.
2. The Base Case is generally the system with the lowest initial cost.

Base Case Totals			
Recommended Systems Totals			
Difference (Base Case minus Recommended)			

Section 3: Project Identification

The second form required is the Identification form (refer to the following page). The form is divided into four topic areas including a project summary, institution contact information, design professional contact information, and special design consideration sections. Information provided is to be as complete and accurate as possible.

The Project Summary section includes general information about the building such as the location as well as specific building design information. Many of the items are self-explanatory and some only require a yes or no answer, however, an explanation for a few of the items is provided below.

- **Building Type** - describe the use of the building (such as elementary school, middle school, high school, library, office building, courthouse, police station, etc.).
- **Slab-on-grade** – does the building consist of slab-on-grade construction?
- **Partially below grade** – does the building have a basement or a partially exposed basement?
- **Mechanical cooling?** Is the building cooled?
- **Renewable resources used?** Are solar collectors (photovoltaic or solar thermal), wind turbines, etc. intended for the project?
- **On-site electric generation?** Is electric generation intended for the project, including engine generators, wind turbines, etc.?
- **Estimated annual occupancy hours** – what is the intended annual occupancy hours of the primary tenant?

The next two sections are to provide project contact information for the institution, the architect, and the engineer (including support staff) involved in the report preparation.

The final section provides space to describe special design considerations requested by the institution. Design constraints that affect system alternatives selection must be documented here as well as in the report.

Project Identification

Project Summary

Project Name _____
 Institution Name _____
 City _____ State _____ Zip _____
 Building Type _____ Building Square Footage _____
 Number of Floors _____ Estimated Number of Occupants _____
 Slab-on-grade? _____ Partially below grade? _____
 Mechanical cooling? _____ Renewable resources used? _____
 On-site electric generation? _____ Estimated annual occupancy hours _____

Institution Contact

Contact Person _____ Title _____
 Telephone _____
 Fax _____

Design Professional Contacts

Architectural Firm _____
 Architect Name _____ Title _____
 Support Staff Name _____ Title _____
 City _____ State _____ Zip _____
 Telephone _____
 Fax _____

Engineering Firm _____
 Engineer Name _____ Title _____
 Support Staff Name _____ Title _____
 City _____ State _____ Zip _____
 Telephone _____
 Fax _____

Special Design Considerations _____

Section 4: Assumptions Form

The Assumptions Form provides a central location for documenting assumptions made in the analysis (refer to the next page). Assumptions regarding initial energy rates used in the analysis are to be provided. The energy rates should be entered for both summer and winter, as applicable. In the case of on-site electricity generation, this should also include information about utility buyback rates.

The next area provides a location to document other assumptions made in the analysis. Examples of other assumptions include the quantity of domestic hot water used annually, maintenance costs, and salvage costs.

The final area on the Assumptions Form provides a location to document references used. These references include, but are not limited to, those used to perform calculations and those used to estimate construction costs. Additional pages may be added as necessary to list all of the assumptions and references.

Assumptions Form

Estimated Average Initial Fuel Costs:

	Summer	Winter
Natural Gas (\$/Therm)		
Electricity (\$/kWh)		
Electricity (\$/kW Demand)		
Liquefied Petroleum Gas (LPG) (\$/gal)		
Other (Specify)		
Assumptions Relating to Fuel Costs <hr/> <hr/> <hr/> <hr/> <hr/>		

Other Assumptions

1.

2.

3.

References

1.

2.

3.

Section 5: Life-Cycle Cost Analysis

The life cycle cost calculations for each alternative are to be presented in this section of the report. The analyst has the option of using the forms provided in the Appendix of the Guidelines (a set of three pages) or provide a printout of computer input and output for each case.

The forms provided in the Appendix of the Guidelines come from Appendix C of the *Life-Cycle Costing Manual for the Federal Energy Management Program*, National Institute for Standards and Technology (NIST) Handbook 135, 1995 Edition. This manual can be ordered or downloaded on the internet as mentioned previously. Directions for the use of each form are presented on the adjoining pages.

Computer programs or spreadsheets can be used to do life cycle costing calculations. A preferred program is the Building Life-Cycle Cost (BLCC) program developed by the National Institute of Standards and Technology (NIST). This free program is available on the internet at:

<http://www.eren.doe.gov/femp/techassist/softwaretools/softwaretools.html>

At least fifteen alternative cases are to be studied (eighteen if the project includes on-site electricity generation). A set of forms or computer input and output are to be presented for each case.

The analysis of each system (domestic hot water, lighting, envelope/HVAC, and electricity generation) should begin with a base case that would be expected to provide the lowest installed cost but, due to lower efficiency, usually result in high operating and life cycle costs. The other options should provide a tradeoff of higher installed cost for lower operating and (potentially) lower life cycle costs. In each case, the system with the lowest life cycle cost must be recommended.

Domestic Hot Water

Select three domestic hot water systems and document the rationale used to justify their consideration for the facility. Systems selection could compare varying efficiency levels, systems using different fuels, a central system versus a distributed system, a solar-assisted versus a non-assisted system, a variety of control strategies, or large equipment versus a modular installation, for example.

Lighting

Choose three lighting systems for the primary use of the building (classrooms for example) and document the rationale used to justify their consideration for the facility. Include a variety of lamp types, ballast features, and control strategies.

The analysis may also require the study of secondary use lighting (such as for gymnasiums and for parking lots, for example).

Building Envelope and HVAC Systems

Choose three building envelope types and three HVAC systems and document the rationale used to justify their consideration for the facility. A total of nine building / HVAC combinations must be studied. The design alternatives recommended previously for the domestic hot water system and for the lighting system should be used in the analysis of the envelope and HVAC systems.

Building envelope parameters may vary wall and roof insulation type and thickness, and window type. HVAC system parameters may vary system type, modular equipment, distribution system type, control strategies, etc.

On-Site Electricity Generation

When applicable, use all of the recommended building systems to evaluate three design alternatives for on-site electricity generation. Potential alternatives include engine generators, micro-turbines, fuel cells, steam turbines, wind turbines, solar arrays (photovoltaic), etc. In the case of wind turbine electricity generation, refer to the Department's current version of the *Wind Feasibility Study Guidelines* for requirements of Preliminary Assessment Reports.

Recommended Systems

Briefly note each of the recommended systems, however, most of this discussion should be provided in the Executive Summary. The set of combined systems should be used to find the detailed energy use prediction on the Life-Cycle Cost Analysis form in the Executive Summary.

Section 6: Appendix

The report appendix is to include supporting information. The contents of the appendix should include sketches of the planned building layout, energy use calculations, and any other pertinent information necessary to document the recommendations made.

GUIDELINE APPENDICES

Appendix A

Life Cycle Cost Analysis Forms

1. Project Identification INSTRUCTIONS

Step 1. PROJECT IDENTIFICATION

- Enter project name and fiscal year.
- Enter location. Enter DoE region (from *Annual Supplement*).
- Enter Base Date and Service Date.
- Enter design feature to be evaluated.
- List constraints. Add page if needed.
- Designate study as energy conservation study or OMB study.

Step 2. BASE CASE AND ALTERNATIVES

- Give title and brief description of base case and alternatives to be analyzed.

Step 3. GENERAL INFORMATION

- Enter name of analyst, telephone number, and date study was completed.

Project Title _____ Alt. ID _____

TYPE OF COST OR BENEFIT (1)	(2)	(3)		(4)		(5)	(6)	(7)
One-Time Amounts	\$-Amount on BD \$ x 10 ³ [] \$ x 10 ⁶ []	Years from		Investment-related?		Data Source	Diff. Esc. Rate	Discount Factor Table
		BD	SD	Yes	No			No.
Annually Recurring Amounts	\$-Amount on BD \$ x 10 ³ [] \$ x 10 ⁶ []	Number of Payments from		Investment-related?		Data Source	Diff. Esc. Rate	Discount Factor Table
		SD		Yes	No			No.
Water:								
Energy:							Diff. Esc. Rates for ENERGY Projects Embedded in Discount Factors	

BD = Base Date
SD = Service Date

3. Input Data Summary INSTRUCTIONS

Step 1. IDENTIFICATION OF ALTERNATIVE

- Enter project title and identification data for alternative from *Project Identification* worksheet.

Step 2. ANALYSIS INPUT DATA

Col. (1) Enter types of costs or benefits as of the Base Date (BD):

One-time amounts:

Examples: Planning/Construction (P/C) or Acquisition Costs
Capital Replacement Costs
Major Repair Costs
Disposal Costs
Resale, Retention, or Salvage Value

Note: P/C or Acquisition Costs may be assumed to occur in a lump sum at the beginning of the study period. All other one-time costs are assumed to occur at any time during the analysis period, the specific time depending on when they are actually expected to occur.

Annually recurring amounts:

Examples: Routine OM&R Costs and Custodial Costs
Energy Costs: Electricity, distillate, residual, etc.
Water Costs

Col. (2) Enter \$-amounts as of the Base Date. (Designate as thousands or millions.)

Col. (3) For **one-time amounts**, enter the number of years after the Base Date (BD) and Service Date (SD) for which the costs or benefits occur.
For **annually recurring amounts**, enter the number of annual payments expected over the length of the study period.

Col. (4) Designate as investment-related or non-investment-related.

Col. (5) List data sources on a separate sheet and enter references here.

Col. (6) Enter differential escalation rates(s) for costs other than energy, if applicable.

Col. (7) Enter number of appropriate Discount Factor Table (for region, fuel type, sector, discount rate, differential escalation rate) from *Annual Supplement to Handbook 135*.

LIFE-CYCLE COST ANALYSIS

4. PRESENT-VALUE CALCULATIONS

Project Title _____ Alt. ID _____

(1) INVESTMENT- RELATED AMOUNTS	(2) \$-Amount on BD \$ x 10 ³ [] \$ x 10 ⁶ []	(3) Discount Factor	(4) Present Value (4) = (2)x(3)	(5) PV TOTALS (5) = Summation of (4) by type
				Initial Investment \$ _____
				Capital Replacements + \$ _____
				Disposal Costs + \$ _____
				Salvage/ Resale Value - \$ _____
				TOTAL INV.- RELATED COSTS \$ <input type="text"/>
OPERATION-RELATED AMOUNTS	\$-Amount on BD \$ x 10 ³ [] \$ x 10 ⁶ []	Discount Factor	Present Value (4) = (2)x(3)	
				Annual OM&R \$ _____
				Non-Annual OM&R + \$ _____
				Energy + \$ _____
				Water + \$ _____
				Other ± \$ _____
				TOTAL OPERATION- REL. COSTS \$ <input type="text"/>
TOTAL PV LIFE-CYCLE COSTS			=	\$ _____

BD = Base Date

4. Present-Value Calculations INSTRUCTIONS

Step 1. IDENTIFICATION OF ALTERNATIVES

- Enter project name and identification data for base case or alternative.

Step 2. PRESENT VALUE CALCULATION

- | | |
|----------|--|
| Col. (1) | Enter costs and benefits by category (investment-related or operation-related). |
| Col. (2) | Enter \$-amounts as of the Base Date, from column (2) of <i>Input Data Summary</i> . |
| Col. (3) | Enter discount factors from tables identified in column (7) of <i>Input Data Summary</i> . |
| Col. (4) | Multiply \$-amount (column (2)) by discount factor (column (3)) and enter present value in column (4). |

Step 3. LIFE-CYCLE COST CALCULATION

- | | |
|----------|--|
| Col. (5) | <ul style="list-style-type: none"> • Sum all investment-related costs (including resale, retention, or salvage values, if any, that have to be subtracted from costs). Enter in box. • Sum all operation-related costs and enter in box. • Add total investment-related costs and total operation-related costs from boxes and enter Total PV Life-Cycle Costs for alternative in bottom part of worksheet. |
|----------|--|

Appendix B

Applicable Iowa Laws

Iowa Code 2001

<http://www2.legis.state.ia.us/IACODE/2001/>

Some portions of the 2001 Code have not been formatted for electronic distribution yet. Please refer to the printed version for the official version.

CHAPTER 72 DUTIES RELATING TO PUBLIC CONTRACTS

72.1 Contracts for excess expenditures--exception for coal.

Officers empowered to expend, or direct the expenditure of, public money of the state shall not make any contract for any purpose which contemplates an expenditure of such money in excess of that authorized by law. However, the state or an agency of the state may enter into a contract of not exceeding ten years in duration for the purchase of coal to be used in facilities under the jurisdiction of the state or the state agency. The execution of the contract shall be contingent upon appropriations by the general assembly in sufficient amounts to meet the terms of the contract.

72.2 Executive council may authorize indebtedness.

Nothing herein contained shall prevent the incurring of an indebtedness on account of support funds for state institutions, upon the prior written direction of the executive council, specifying the items and amount of such indebtedness to be increased, and the necessity therefor.

72.3 Divulging contents of sealed bids.

No public officer or deputy thereof, if any, shall directly or indirectly or in any manner whatsoever, at any other time or in any other manner than as provided by law, open any sealed bid or convey or divulge to any person any part of the contents of a sealed bid, on any proposed contract concerning which a sealed bid is required or permitted by law.

72.4 Penalty.

A violation of the provisions of section 72.3 shall, in addition to criminal liability, render the violator liable, personally and on the violator's bond, if any, to liquidated damages in the sum of one thousand dollars for each violation, to inure to and be collected by the state, county, city, school corporation or other municipal corporation of which the violator is an officer or deputy.

72.5 Life cycle cost.

1. A contract for a public improvement or construction of a public building, including new construction or renovation of an existing public building, by the state, or an agency of the state, shall not be let without satisfying the following requirements:

- a. A design professional submitting a design development proposal for consideration of the public body shall at minimum prepare one proposal meeting the design program's space and use requirements which reflects the lowest life cycle cost possible in light of existing commercially available technology.
- b. Submission of a cost benefit analysis of any deviations from the lowest life cycle cost proposal contained in other design proposals requested by or prepared for submission to the public body.

The public body may request additional design proposals in light of funds available for construction, aesthetic considerations, or any other reason.

This subsection applies for all design development proposals requested on or after January 1, 1991.

2. In connection with development of a statewide building energy efficiency rating system, pursuant to section 473.40, the director of the department of natural resources in consultation with the department of management, state building code director, and state fire marshal, shall develop standards and methods to evaluate design development documents and construction documents based upon the energy efficiency rating system for public buildings, and other life cycle cost factors, to facilitate fair and uniform comparisons between design proposals and informed decision making by public bodies.

3. The department of management shall develop a proposal for submission to the general assembly on or before January 10, 1991, to create a division within the department of management to evaluate life cycle costs on design proposals submitted on public improvement and construction contracts for agencies of the state, to assure uniform comparisons and professional evaluations of design proposals by an independent agency. The report shall also address potential redundancy and conflicts within existing state law regarding life cycle cost analysis and recommend the resolution of any problems which are identified.

4. It is the intent of the general assembly to discourage construction of public buildings based upon lowest acquisition cost, and instead to require that such decisions be based upon life cycle costs to reduce energy consumption, maintenance requirements, and continuing burdens upon taxpayers.

CHAPTER 470 LIFE CYCLE COST ANALYSIS OF PUBLIC FACILITIES

470.1 Definitions.

As used in this chapter unless the context otherwise requires:

1. "Commissioner" means the state building code commissioner.
2. "Department" means the department of natural resources.
3. "Director" means the director of the department of natural resources.
4. "Economic life" means the projected or anticipated useful life of a facility as expressed by a term of years.
5. "Energy system" includes but is not limited to the following equipment or measures:
 - a. Equipment used to heat or cool the facility.
 - b. Equipment used to heat water in the facility.
 - c. On-site equipment used to generate electricity for the major facility.
 - d. On-site equipment that uses the sun, wind, oil, natural gas, coal or electricity as a power source.
 - e. Energy conservation measures in the facility design and construction that decrease the energy requirements of the facility.
6. "Facility" means a building having twenty thousand square feet or more of usable floor space that is heated or cooled by a mechanical or electrical system or any building, system, or physical operation which consumes more than forty thousand British thermal units (BTUs) per square foot per year.
7. "Initial cost" means the moneys required for the capital construction or renovation of a facility.
8. "Life cycle cost analysis" means an analytical technique that considers certain costs of owning, using and operating a facility over its economic life including but not limited to the following:
 - a. Initial costs.
 - b. System repair and replacement costs.
 - c. Maintenance costs.
 - d. Operating costs, including energy costs.
 - e. Salvage value.
9. "Public agency" means a state agency, political subdivision of the state, school district, area education agency, or community college.
10. "Renovation" means a project where additions or alterations exceed fifty percent of the value of a facility and will affect an energy system.

470.2 Policy--analysis required.

The general assembly declares that energy management is of primary importance in the design of publicly owned facilities. Commencing January 1, 1980, a public agency responsible for the construction or renovation of a facility shall, in a design begun after that date, include as a design criterion the requirement that a life cycle cost analysis be conducted for the facility. The objectives of the life cycle cost analysis are to optimize energy efficiency at an acceptable life cycle cost. The life cycle cost analysis shall meet the requirements of section 470.3.

470.3 Elements of analysis.

1. A life cycle cost analysis shall include but is not limited to the following elements:
 - a. Specification of energy management objectives and health, safety and functional constraints. The facility design shall comply with applicable state or local building code requirements.
 - b. Identification of the energy needs of the facility and energy system alternatives to meet those needs.
 - c. Cost of the energy system alternatives identified in paragraph "b" of this subsection.
 - d. Determination of amounts and timing of cash flow.
 - e. Calculation of life cycle cost using an economic model such as, but not limited to, rate of return, annual equivalent cost or present equivalent cost.

f. Evaluation of design and system alternatives using a method such as, but not limited to, design matrixes, ranking tables or network analysis.

2. A public agency or a person preparing a life cycle cost analysis for a public agency shall consider the methods and analytical models provided by the department and available through the commissioner, which are suited to the purpose for which the project is intended. Within sixty days of final selection of a design architect or engineer, a public agency, which is also a state agency under section 7D.34, shall notify the commissioner and the department of the methodology to be used to perform the life cycle cost analysis, on forms provided by the department.

470.4 Analysis approved.

The life cycle cost analysis shall be approved by the public agency before contracts for the construction or renovation are let. A public agency may accept a facility design and shall meet the requirements of this chapter if the design meets the operational requirements of the agency and provides the optimum life cycle cost. The public agency shall retain a copy of the life cycle cost analysis and a statement justifying a design decision both of which shall be available for public inspection at reasonable hours.

470.5 Exceptions.

This chapter does not apply to buildings used on January 1, 1980 by the division of adult corrections of the department of human services as maximum security detention facilities or to the renovation of property nominated to, or entered in the national register of historic places, designated by statute, or included in an established list of historic places compiled by the historical division of the department of cultural affairs.

470.6 Restriction on use of public funds.

Public funds shall not be used for the construction or renovation of a facility unless the design for the work is prepared in accordance with this chapter and the actual construction or renovation meets the requirements of the design.

470.7 Life cycle cost analysis--approval.

The public agency responsible for the new construction or renovation of a public facility shall submit a copy of the life cycle cost analysis for review by the commissioner who shall consult with the department. If the public agency is also a state agency under section 7D.34, comments by the department or the commissioner, including any recommendation for changes in the analysis, shall, within thirty days of receipt of the analysis, be forwarded in writing to the public agency. If either the department or the commissioner disagrees with any aspects of the life cycle cost analysis, the public agency affected shall timely respond in writing to the commissioner and the department. The response shall indicate whether the agency intends to implement the recommendations and, if the agency does not intend to implement them, the public agency shall present its reasons. The reasons may include, but are not limited to, a description of the purpose of the facility or renovation, preservation of historical architectural features, architectural and site considerations, and health and safety concerns.

Within thirty days of receipt of the response of the public agency affected, the department, the commissioner, or both, shall notify in writing the public agency affected of the department's, the commissioner's, or both's agreement or disagreement with the response. In the event of a disagreement, the department, the commissioner, or both, shall at the same time transmit the notification of disagreement with response and related papers to the executive council for resolution pursuant to section 7D.34. The life cycle cost analysis process, including submittal and approval, and implementation exemption requests pursuant to section 470.8, shall be completed prior to the letting of contracts for the construction or renovation of a facility.

470.8 Life cycle cost analysis--implementation and exemptions.

The public agency responsible for the new construction or renovation of a public facility shall implement the recommendations of the life cycle cost analysis.

The commissioner, in consultation with the director, shall, by rule, develop criteria to exempt facilities from the implementation requirements of this section. Using the criteria, the commissioner, in cooperation with the director, shall exempt facilities on a case by case basis. Factors to be considered when developing the exemption criteria shall include, but not be limited to, a description of the purpose of the facility or renovation, the preservation of historical architectural features, site considerations, and health and safety concerns. The commissioner and the director shall grant or deny a request for exemption from the requirements of this section within thirty days of receipt of the request.

CHAPTER 473 ENERGY DEVELOPMENT AND CONSERVATION

473.1 Definitions.

As used in this chapter, unless the context otherwise requires:

1. "Commission" means the environmental protection commission of the department.
2. "Department" means the department of natural resources created under section 455A.2.
3. "Director" means the director of the department or a designee.
4. "Energy" or "energy sources" means gasoline, fuel oil, natural gas, propane, coal, special fuels and electricity.

5. "Supplier" means any person engaged in the business of selling, importing, storing or generating energy sources in Iowa.

473.2 Findings.

The general assembly finds that the health, welfare, and prosperity of all Iowans require the provision of adequate, efficient, reliable, environmentally safe, and least-cost energy at prices which accurately reflect the long-term cost of using such energy resources and which are equitable to all Iowans. The goals and objectives of this policy are to ensure the following:

1. *Efficiency.* The provision of reliable energy at the least possible cost to Iowans in such manner that:

a. Physical, human, and financial resources are allocated efficiently.

b. All supply and demand options are considered and evaluated using comparable terms and methods in order to determine how best to meet consumers' demands for energy at the least cost.

2. *Environmental quality.* The protection of the environment from the adverse external costs of an energy resource utilization so that:

a. Environmental costs of proposed actions having a significant impact on the environment and the environmental impact of the alternatives are identified, documented, and considered in the resource development.

b. The prudently and reasonably incurred costs of environmental controls are recovered.

473.3 Energy efficiency goal.

The goal of this state is to more efficiently utilize energy resources, especially those that are nonrenewable or that have negative environmental impacts, in order to enhance the economy of the state and to decrease the state's dependence on energy resources from outside the state by reducing the amount of energy used. This goal is to be implemented through the development of programs that promote energy efficiency and energy conservation by all Iowans, through the development and enhancement of an energy efficiency industry, through the development of indigenous energy resources that are economically and environmentally viable, and through the development and implementation of effective public information and education programs.

State government shall be a model and testing ground for the use of energy efficiency systems.

473.4 through 473.6

Reserved.

473.7 Duties of the department.

The department shall:

1. Deliver to the general assembly by January 15, 1990, a plan for the development, management, and efficient utilization of all energy resources in the state. The plan shall evaluate existing energy utilization with regard to energy efficiency and shall evaluate the future energy needs of the state. The plan shall include but is not limited to the following elements:

a. The historical use and distribution of energy in Iowa.

b. The growth rate of energy consumption in Iowa.

c. A projection of Iowa's energy needs at a minimum of ten years into the future.

d. The impact of meeting Iowa's energy needs on the economy of the state.

e. The impact of meeting Iowa's energy needs on the environment of the state.

f. An evaluation of alternative sources and uses of energy.

g. Legislative recommendations that may be necessary as a basis for a state policy for the development and efficient utilization of energy resources.

h. An evaluation of the ability of existing laws and regulations surrounding the utilization of energy resources.

The department shall develop the plan with the assistance of, and in consultation with, representatives of the energy industry, economic interests, the public, and other interested parties. The department shall submit a report to the general assembly concerning the status and implementation of the plan on a biennial basis. The biennial update shall contain an evaluation of all state energy programs including expected versus actual benefits and forecasts of future energy demand in Iowa.

2. Identify a state facility in the state to be used as a marketing tool to promote energy conservation by providing a showcase for the department to demonstrate energy efficiency.

3. The department shall exchange information with other states on energy and especially on the allocation of fuel and shall request all information necessary to determine the reasonableness of any reduction of Iowa's fuel allocation.

4. Establish a central depository within the state for energy data. The central depository shall be located at or accessible through a library which is a member of an interlibrary loan program to facilitate access to the data and information contained in the central depository. The department shall collect data necessary to forecast future energy demands in the state. The department may require a supplier to provide information pertaining to the supply, storage, distribution and sale of energy sources in this state. The information shall be furnished on a periodic basis, shall be of a nature which directly relates to the supply, storage, distribution and sale of energy sources, and shall not include any records, documents, books or other data which relate to the financial position of the supplier. Provided the department, prior to requiring any supplier to furnish it with such information, shall make every reasonable effort to determine if the same is available from any other governmental source. If it finds such information is available, the department shall not require submission of the same from a supplier. Notwithstanding the provisions of chapter 22, information and reports obtained under this section shall be confidential except when used for statistical purposes without identifying a specific supplier and when release of the information will not give an advantage to competitors and serves a public purpose. The department shall use this data to conduct energy forecasts which shall be included in the biennial update required by this section.

The department may subpoena witnesses, administer oaths and require the production of records, books, and documents for examination in order to obtain information required to be submitted under this section. In case of failure or refusal on the part of any person to comply with a subpoena issued by the department, or in case of the refusal of any witness to testify as to any matter regarding which the witness may be interrogated under this chapter, the district court, upon the application of the department, may order the person to show cause why the person should not be held in contempt for failure to testify or comply with a subpoena, and may order the person to produce the records, books, and documents for examination, and to give testimony. The courts may punish for contempt as in the case of disobedience to a like subpoena issued by the court, or for refusal to testify.

5. Develop, recommend, and implement with appropriate agencies public and professional education and communication programs in energy efficiency, energy conservation, and conversion to alternative sources of energy.

6. When necessary to carry out its duties under this chapter, enter into contracts with state agencies and other qualified contractors.

7. Receive and accept grants made available for programs relating to duties of the department under this chapter.

8. Promulgate rules necessary to carry out the provisions of this chapter, subject to review in accordance with chapter 17A. Rules promulgated by the governor pursuant to a proclamation issued under the provisions of section 473.8 shall not be subject to review or a public hearing as required in chapter 17A; however, agency rules for implementation of the governor's proclamation are subject to the requirements of chapter 17A.

9. Examine and determine whether additional state regulatory authority is necessary to protect the public interest and to promote the effective development, utilization and conservation of energy resources. If the department finds that additional regulatory authority is necessary, the department shall submit recommendations to the general assembly concerning the nature and extent of such regulatory authority and which state agency should be assigned such regulatory responsibilities.

10. Develop and assist in the implementation of public education and communications programs in energy development, use and conservation, in co-operation with the department of education, the state university extension services and other public or private agencies and organizations as deemed appropriate by the department.

11. Develop a program to annually give public recognition to innovative methods of energy conservation.

12. Administer and coordinate federal funds for energy conservation programs including, but not limited to, the institutional conservation program, state energy conservation program, and energy extension service program, and related programs which provide energy management and conservation assistance to schools, hospitals, health-care facilities, communities, and the general public.

13. Administer and coordinate the state building energy management program including projects funded through private financing.

14. Perform monthly fuel surveys which establish a statistical average of motor fuel prices for various motor fuels provided throughout the state. Additionally, the department shall perform monthly fuel surveys in cities with populations of over fifty thousand which establish a statistical average of motor fuel prices for various motor fuels provided in those individual cities. The survey results shall be publicized in a monthly press release issued by the department.

15. Conduct a study on activities related to energy production and use which contribute to global climate change and the depletion of the stratospheric ozone layer. The study shall identify the types and relative contributions of these activities in Iowa. The department shall develop a strategy to reduce emissions from activities identified as having an adverse impact on the global climate and the stratospheric ozone layer. The department shall submit a report containing its findings and recommendations to the governor and general assembly by January 1, 1992.

473.8 Emergency powers.

If the department by resolution determines the health, safety, or welfare of the people of this state is threatened by an actual or impending acute shortage of usable energy, it shall transmit the resolution to the governor together with its recommendation on the declaration of an emergency by the governor and recommended actions, if any, to be undertaken. Within thirty days of the date of the resolution, the governor may issue a proclamation of emergency which shall be filed with the secretary of state. The proclamation shall state the facts relied upon and the reasons for the proclamation.

Pursuant to the proclamation of an emergency or in response to a declaration of an energy emergency by the president of the United States under the federal Emergency Energy Conservation Act of 1979, Pub. L. No. 96-102, the governor by executive order may:

1. Regulate the operating hours of energy consuming instrumentalities of state government, political subdivisions, private institutions and business facilities to the extent the regulation is not hazardous or detrimental to the health, safety, or welfare of the people of this state. However, the governor shall have no authority to suspend, amend or nullify any service being provided by a public utility pursuant to an order or rule of a federal agency which has jurisdiction over the public utility.
2. Establish a system for the distribution and supply of energy. The system shall not include a coupon rationing program, unless the program is federally mandated.
3. Curtail public and private transportation utilizing energy sources. Curtailment may include measures designed to promote the use of car pools and mass transit systems.
4. Delegate any administrative authority vested in the governor to the department or the director.
5. Provide for the temporary transfer of directors, personnel, or functions of state departments and agencies, for the purpose of performing or facilitating emergency measures pursuant to subsections 1 and 2.
6. Accept the delegation of other mandatory measures as allowed by the federal Emergency Energy Conservation Act of 1979, Pub. L. No. 96-102.

If the general assembly is in session, it may revoke by concurrent resolution any proclamation of emergency issued by the governor. If the general assembly is not in session, the proclamation of emergency by the governor may be revoked by a majority vote of the standing membership of the legislative council. Such revocation shall be effective upon receipt of notice of the revocation by the secretary of state and any functions being performed pursuant to the governor's proclamation shall cease immediately.

A violation of an executive order of the governor issued pursuant to this section is a scheduled violation as provided in section 805.8C, subsection 1. If the violation is continuous and stationary in its nature and subsequent compliance can easily be ascertained, an officer may issue a memorandum of warning in lieu of a citation providing a reasonable amount of time not exceeding fourteen days to correct the violation and to comply with the requirements of the executive order.

473.9 Set-aside definitions.

As used in section 473.10 unless the context otherwise requires:

1. "*Hardship*" means a situation involving or potentially involving substantial discomfort or danger or economic dislocation caused by a shortage or distribution imbalance of a liquid fossil fuel.
2. "*Liquid fossil fuel*" means heating oils, diesel oil, motor gasoline, propane, residual fuel oils, kerosene, and aviation fuels.
3. "*Prime supplier*" means an individual, trustee, agency, partnership, association, corporation, company, municipality, political subdivision or other legal entity that makes the first sale of a liquid fossil fuel into the state distribution system for consumption within the state.

473.10 Reserve required.

1. If the department or the governor finds that an impending or actual shortage or distribution imbalance of liquid fossil fuels may cause hardship or pose a threat to the health and economic well-being of the people of the state or a significant segment of the state's population, the department or the governor may authorize the director to operate a liquid fossil fuel set-aside program as provided in subsection 2.
2. Upon authorization by the department or the governor the director may require a prime supplier to reserve a specified fraction of the prime supplier's projected total monthly release of liquid fossil fuel in Iowa. The director may release any or all of the fuel required to be reserved by a prime supplier to end-users or to distributors for release through normal retail distribution channels to retail customers. However, the specified fraction required to be reserved shall not exceed three percent for propane, aviation fuel and residual oil, and five percent for motor gasoline, heating oil, and diesel oil.
3. The department shall periodically review and may terminate the operation of a set-aside program authorized by the department under subsection 1 when the department finds that the conditions that prompted the authorization no longer exist. The governor shall periodically review and may terminate the operation of a set-aside program authorized by the governor under subsection 1 when the governor finds that the conditions that prompted the authorization no longer exist.
4. The director shall adopt rules to implement this section.

473.11 Energy conservation trust established--receipts and disbursements.

1. a. The energy conservation trust is created within the state treasury. This state, on behalf of itself, its citizens, and its political subdivisions accepts any moneys awarded or allocated to the state, its citizens, and its political subdivisions as a result of the federal court decisions and United States department of energy settlements resulting from alleged violations of federal petroleum pricing regulations and deposits the moneys in the energy conservation trust.
- b. The energy conservation trust is established to provide for an orderly, efficient, and effective mechanism to make maximum use of moneys available to the state, in order to increase energy conservation efforts and thereby to save the citizens of this state energy expenditures. The moneys in the funds in the trust shall be expended only upon appropriation by the general assembly and only for programs which will benefit citizens who may have suffered economic penalties resulting from the alleged petroleum overcharges.

c. The moneys awarded or allocated from each court decision or settlement shall be placed in a separate fund in the energy conservation trust. Notwithstanding section 12C.7, interest and earnings on investments from moneys in the trust shall be credited proportionately to the funds in the trust.

d. Unless prohibited by the conditions applying to a settlement, the petroleum overcharge moneys in the energy conservation trust may be used for the payment of attorney fees and expenses incurred by the state to obtain the moneys and shall be paid by the director of revenue and finance from the available moneys in the trust subject to the approval of the attorney general.

e. However, petroleum overcharge moneys received pursuant to claims filed on behalf of the state, its institutions, departments, agencies, or political subdivisions shall be deposited in the general fund of the state to be disbursed directly to the appropriate claimants in accordance with federal guidelines and subject to the approval of the attorney general.

f. The moneys deposited under section 473.16 in the general fund of the state shall be used for research and development of selected projects to improve Iowa's energy independence by developing improved methods of energy efficiency, or by increased development and use of Iowa's renewable nonresource-depleting energy resources. The moneys credited to the general fund of the state under section 556.18, subsection 3, shall be used for energy conservation and alternative energy resource projects. The projects shall be selected by the director and administered by the department. Selection criteria for funded projects shall include consideration of indirect restitution to those persons in the state in the utility customer classes and the utility service territories affected by unclaimed utility refunds or deposits.

Moneys deposited into the general fund of the state under sections 473.16, 476.51, and 556.18, subsection 3, are subject to the requirements of section 8.60.

2. The treasurer of state shall be the custodian of the energy conservation trust and shall invest the moneys in the trust, in consultation with the energy fund disbursement council established in subsection 3 and the investment board of the Iowa public employees' retirement system, in accordance with the following guidelines:

a. To maximize the rate of return on moneys in the trust while providing sufficient liquidity to make fund disbursements, including contingency disbursements.

b. To absolutely insure the trust against loss.

c. To use such investment tools as are necessary to achieve these purposes.

3. An energy fund disbursement council is established. The council shall be composed of the governor or the governor's designee, the director of the department of management, who shall serve as the council's chairperson, the administrator of the division of community action agencies of the department of human rights, the administrator of the energy and geological resources division of the department of natural resources, and a designee of the director of transportation, who is knowledgeable in the field of energy conservation. The council shall include as nonvoting members two members of the senate appointed by the president of the senate, after consultation with the majority leader and the minority leader of the senate, and two members of the house of representatives appointed by the speaker of the house, after consultation with the majority leader and the minority leader of the house. The legislative members shall be appointed upon the convening and for the period of each general assembly. Not more than one member from each house shall be of the same political party. The council shall be staffed by the energy and geological resources division of the department of natural resources. The attorney general shall provide legal assistance to the council.

The council shall do all of the following:

a. Oversee the investment of moneys deposited in the energy conservation trust.

b. Make recommendations to the governor and the general assembly regarding annual appropriations from the energy conservation trust.

c. Work with the energy and geological resources division in adopting administrative rules necessary to administer expenditures from the trust, encourage applications for grants and loans, review and select proposals for the funding of competitive grants and loans from the energy conservation trust, and evaluate their comparative effectiveness.

d. Monitor expenditures from the trust.

e. Approve any grants or contracts awarded from the energy conservation trust in excess of five thousand dollars.

f. Prepare, in conjunction with the energy and geological resources division, an annual report to the governor and the general assembly regarding earnings of and expenditures from the energy conservation trust.

4. The administrator of the energy and geological resources division of the department of natural resources shall be the administrator of the energy conservation trust. The administrator shall disburse moneys appropriated by the general assembly from the funds in the trust in accordance with the federal court orders, law and regulation, or settlement conditions applying to the moneys in that fund, and subject to the approval of the energy fund disbursement council if such approval is required. The council, after consultation with the attorney general, shall immediately approve the disbursement of moneys from the funds in the trust for projects which meet the federal court orders, law and regulations, or settlement conditions which apply to that fund.

5. The following funds are established in the energy conservation trust:

a. The Warner/Imperial fund.

- b. The Exxon fund.
- c. The Stripper Well fund.
- d. The Diamond Shamrock fund.
- e. The office of hearings and appeals second-stage settlement fund.

6. The moneys in the fund in the energy conservation trust distributed to the state as a result of the federal court decisions finding oil companies in violation of federal petroleum pricing regulations shall be expended expeditiously, until all the receipts are depleted and shall be disbursed for projects which meet the strict guidelines of the five existing federal energy conservation programs specified in Pub. L. No. 97-377, § 155, 96 Stat. 1830, 1919 (1982). The council shall approve the disbursement of moneys from the fund in the trust for other projects only if the projects meet one or more of the following conditions:

- a. The projects meet the guidelines for allowable projects under a modification order entered by the federal court in the case involving Exxon corporation.
- b. The projects meet the guidelines for allowable projects under a directive order entered by the federal court in the case involving Exxon corporation.
- c. The projects meet the guidelines for allowable projects under the regulations adopted or written clarifications issued by the United States department of energy.
- d. The projects meet the guidelines for allowable projects under the petroleum violation settlement agreement expenditure plan approved by the United States department of energy.

7. On June 30, 2003, the energy fund disbursement council established in subsection 3 shall be dissolved. At that time, the department of natural resources shall be responsible for the disbursement of any funds either received or remaining in the energy conservation trust. These disbursements shall be for projects and programs consistent with the allowable uses for the energy conservation trust. Also, at that time, and annually thereafter, the state department of transportation shall report to the department of natural resources on the status of the intermodal revolving loan fund established in the department. In the fiscal year beginning July 1, 2019, the department of natural resources shall assume responsibility for funds remaining in the intermodal revolving loan fund and disburse them for energy conservation projects and programs consistent with the allowable uses for the energy conservation trust.

473.12 Implementation of energy conservation measures--state board of regents.

1. The state board of regents shall cause to be performed comprehensive engineering analyses of facilities under the control of the state board of regents and shall implement the energy conservation measures identified in the analyses which are economically feasible and practical and which do not require more than an aggregate period of six years for the recoupment of the cost of construction of the improvements used to secure the implementation of the energy conservation measure. The comprehensive engineering analyses shall be completed no later than June 30, 1989.
2. The department may, pursuant to section 7D.34, reduce the cost of financing for implementation of the energy conservation measures identified, through funds deposited in the state of Iowa facilities improvement corporation established by the department. In order for the state board of regents to receive financing under section 7D.34, the department shall require completion of an energy management plan, including an energy audit and a comprehensive engineering analysis.
3. The state board of regents shall annually report on October 1 to the department the status of all energy conservation measures identified in their comprehensive engineering analysis, whether or not the measures have been acquired or implemented, and the results of energy usage analyses of the board's facilities.

473.13 Implementation of energy conservation measures--state department of transportation.

1. The state department of transportation utilizing the services of the state of Iowa facilities improvement corporation shall cause to be performed comprehensive engineering analyses of facilities under the control of the state department of transportation and shall implement the energy conservation measures identified in the analyses which do not require more than an aggregate period of six years for the recoupment of the cost of construction of the improvements used to secure the implementation of the energy conservation measures. The comprehensive engineering analyses shall be completed no later than December 31, 1988.
2. The department may, pursuant to section 7D.34, reduce the cost of financing for implementation of the energy conservation measures identified, through funds deposited in the state of Iowa facilities improvement corporation established by the department. In order for the state department of transportation to receive financing, the department shall require completion of an energy management plan, including an energy audit and a comprehensive engineering analysis.

473.13A Energy conservation measures identified and implemented.

The state, state agencies, political subdivisions of the state, school districts, area education agencies, and community colleges shall identify and implement, through energy audits and engineering analyses, all energy conservation measures identified for which financing is made available by the department to the entity. The energy conservation measure financings shall be supported through payments from energy savings.

The department shall not require a school district, community college, area education agency, city, or county to perform an engineering analysis if the school district, community college, area education agency, city, or county demonstrates to the department that the facility which is the subject of the proposed engineering analysis at issue is unlikely to be in use or operation in six years by the governmental entity currently using or occupying the facility.

473.14
Reserved.

473.15 Annual report.

The department shall include in the annual report required under section 455A.4 an assessment of the progress achieved by public agencies in implementing energy life cycle cost analyses.

473.16 Additional funds.

The department may accept funds from state and local sources and shall take steps necessary to obtain federal funds allotted and appropriated for the purpose of the above described energy-related programs. These funds shall be deposited in the general fund of the state and shall be subject to the requirements of section 8.60. Federal funds received under the provisions of this section are appropriated for the purposes set forth in the federal grants.

473.17 Review.

The first session of the Seventy-second General Assembly meeting in the year 1987 shall review the activities and performance of the department and shall not later than July 1, 1987 make a determination concerning the status and duties of the department.

473.18
Reserved.

473.19 Energy bank program.

The energy bank program is established by the department. The energy bank program consists of the following forms of assistance for the state, state agencies, political subdivisions of the state, school districts, area education agencies, community colleges, and nonprofit organizations:

1. Providing moneys from the petroleum overcharge fund for conducting energy audits for school districts under section 279.44, for conducting comprehensive engineering analyses for school districts and for conducting energy audits and comprehensive engineering analyses for state agencies, and political subdivisions of the state.
2. Providing loans, leases, and other methods of alternative financing from the energy loan fund established in section 473.20 and section 473.20A for the state, state agencies, political subdivisions of the state, school districts, area education agencies, community colleges, and nonprofit organizations to implement energy conservation measures.
3. Serving as a source of technical support for energy conservation management.
4. Providing assistance for obtaining insurance on the energy savings expected to be realized from the implementation of energy conservation measures.
5. Providing self-liquidating financing for the state, state agencies, political subdivisions of the state, school districts, area education agencies, community colleges, and nonprofit organizations pursuant to section 473.20A.

For the purpose of this section, section 473.20, and section 473.20A, "*energy conservation measure*" means construction, rehabilitation, acquisition, or modification of an installation in a facility or vehicle which is intended to reduce energy consumption, or energy costs, or both, or allow the use of an alternative energy source, which may contain integral control and measurement devices. "*Nonprofit organization*" means an organization exempt from federal income taxation under section 501(c)(3) of the Internal Revenue Code.

473.20 Energy loan fund.

An energy loan fund is established in the office of the treasurer of state to be administered by the department.

1. The department may make loans to the state, state agencies, political subdivisions of the state, school districts, area education agencies, community colleges, and nonprofit organizations for implementation of energy conservation measures identified in a comprehensive engineering analysis. Loans shall be made for all cost-effective energy management improvements. For the state, state agencies, political subdivisions of the state, school districts, area education agencies, community colleges, and nonprofit organizations to receive a loan from the fund, the department shall require completion of an energy management plan including an energy audit and a comprehensive engineering analysis. The department shall approve loans made under this section.
2. Cities and counties shall repay the loans from moneys in their debt service funds. Area education agencies shall repay the loans from any moneys available to them.

School districts and community colleges may enter into financing arrangements with the department or its duly authorized agents or representatives obligating the school district or community college to make payments on the loans beyond the current budget year of the school district or community college. Chapter 75 shall not be applicable. School districts shall repay the loans from moneys in either their general fund or debt service fund. Community colleges shall repay the loans from their general fund. Other entities receiving loans under this section shall repay the loans from any moneys available to them.

3. The department may accept gifts, federal funds, state appropriations, and other moneys for deposit in the energy loan fund or may fund the energy loan fund in accordance with section 473.20A.

4. For the purpose of this section, "loans" means loans, leases, or alternative financing arrangements.

5. The state, state agencies, political subdivisions of the state, school districts, area education agencies, and community colleges shall design and construct the most energy cost-effective facilities feasible and shall use the financing made available by the department to cover the incremental costs above minimum building code energy efficiency standards of purchasing energy efficient devices and materials unless other lower cost financing is available. As used in this section, "facility" means a structure that is heated or cooled by a mechanical or electrical system, or any system of physical operation that consumes energy to carry out a process.

6. The department shall not require the state, state agencies, political subdivisions of the state, school districts, area education agencies, and community colleges to implement a specific energy conservation measure identified in a comprehensive engineering analysis if the entity which prepared the analysis demonstrates to the department that the facility which is the subject of the energy conservation measure is unlikely to be used or operated for the full period of the expected payback of the energy conservation measure.

473.20A Self-liquidating financing.

1. The department of natural resources may enter into financing agreements with the state, state agencies, political subdivisions of the state, school districts, area education agencies, community colleges, or nonprofit organizations in order to provide the financing to pay the costs of furnishing energy conservation measures. The provisions of section 473.20 defining eligible energy conservation measures and the method of repayment of the loans apply to financings under this section.

The financing agreement may contain provisions, including interest, term, and obligations to make payments on the financing agreement beyond the current budget year, as may be agreed upon between the department of natural resources and the state, state agencies, political subdivisions of the state, school districts, area education agencies, community colleges, or nonprofit organizations.

2. For the purpose of funding its obligation to furnish moneys under the financing agreements, or to fund the energy loan fund created in section 473.20, the treasurer of state, with the assistance of the department of natural resources, or the treasurer of state's duly authorized agents or representatives, may incur indebtedness or enter into master lease agreements or other financing arrangements to borrow to accomplish energy conservation measures, or the department of natural resources may enter into master lease agreements or other financing arrangements to permit the state, state agencies, political subdivisions of the state, school districts, area education agencies, community colleges, or nonprofit organizations to borrow sufficient funds to accomplish the energy conservation measure. The obligations may be in such form, for such term, bearing such interest and containing such provisions as the department of natural resources, with the assistance of the treasurer of state, deems necessary or appropriate. Funds remaining after the payment of all obligations have been redeemed shall be paid into the energy loan fund.

3. The state, state agencies, political subdivisions of the state, school districts, area education agencies, community colleges, and nonprofit organizations may enter into financing agreements and issue obligations necessary to carry out the provisions of the chapter. Chapter 75 shall not be applicable.

473.21 through 473.39

Reserved.

473.40 Statewide building energy efficiency rating system.

1. The director shall adopt rules, pursuant to chapter 17A, establishing a statewide building energy efficiency rating system. The rating system shall apply to all new and existing public, commercial, industrial, and residential buildings in the state and shall be established subject to the following schedule:

- a. Ratings for new residential buildings by July 1, 1992.
- b. Ratings for existing residential buildings by July 1, 1993.
- c. Ratings for new public buildings by July 1, 1994.
- d. Ratings for existing public buildings by July 1, 1995.
- e. Ratings for new commercial and industrial buildings by July 1, 1995.
- f. Ratings for existing commercial and industrial buildings by July 1, 1995.

The director shall adopt a minimum acceptable energy efficiency standard for each class of new buildings.

- 2. a. The energy efficiency rating shall be disclosed at the request of the prospective purchaser according to the terms of the offer to purchase.
- b. The energy efficiency rating shall be disclosed to a prospective lessee whose rent does not include energy cost upon request.
- c. The designer of a new residential or commercial building shall state in writing to the department that to the best of the person's knowledge, information, and belief, the new building design is in substantial compliance with the minimum energy efficiency standards established by rule of the department.

d. Concurrent with the disclosure of an energy efficiency rating pursuant to paragraphs "a" through "c", the prospective purchaser or lessee shall be provided with a copy of an information brochure prepared by the department which includes information relevant to that class of building, including, but not limited to:

- (1) How to analyze the building's energy efficiency rating.
- (2) Comparisons to statewide averages for new and existing construction of that class.
- (3) Notice to the prospective purchaser that the seller must disclose a building's energy efficiency rating upon the prospective purchaser's request.
- (4) Information concerning methods to improve a building's energy efficiency rating.
- (5) A notice for residential buyers that qualifying income for mortgage loan purposes may be affected by the energy efficiency rating.

e. A new residential, commercial, or industrial building shall not be hooked up or connected to any provider of electricity, whether a regulated utility, rural electric cooperative, municipal utility, or otherwise; or natural gas, except liquid petroleum, unless the builder states in writing to the utility that to the best of the builder's knowledge, information, and belief, the building was built in accordance with the construction documents.

f. Each public building proposed for construction, renovation, or acquisition shall be rated pursuant to the energy efficiency rating system provided in subsection 1 prior to contracting for the construction, renovation, or acquisition. The public body proposing to contract for construction, renovation, or acquisition for a public building shall consider the energy efficiency ratings of alternatives when contracting.

3. The energy efficiency rating system adopted by the department shall provide a means of analyzing and comparing the relative energy efficiency of buildings upon sale or lease of new or existing residential, commercial, or industrial buildings. The system shall provide for rating each public building in existence to assist public officials in decision making with regard to capital improvements and public energy costs.

4. The director shall establish a voluntary working group of persons and interest groups interested in the energy efficiency rating system or energy efficiency, including, but not limited to such persons as electrical engineers, mechanical engineers, architects, and builders. The interest group shall advise the department in the development of the energy efficiency rating system and shall assist the department in implementation of the rating system by coordinating education programs for designers, builders, businesses, and other interested persons to assist compliance and to facilitate incorporation of the rating system into existing practices. The intent of the general assembly is to encourage the consideration of the energy efficiency rating system in the market, so as to provide market rewards for energy efficient buildings and those designing, building, or selling energy efficient buildings.

5. All public buildings shall be analyzed for energy efficiency using this rating system by July 1, 1996. The results of that analysis shall be submitted to the department by August 1, 1996. The department shall submit a report to the governor and general assembly by January 15, 1997, that analyzes the results of this evaluation of public buildings and includes recommendations. The results of the analysis of each building shall be submitted to the public agency or governmental subdivision which owns or operates that building as well.

6. The director shall make available energy efficiency practices information to be used by individuals involved in the design, construction, retrofitting, and maintenance of buildings for state and local governments.

7. For purposes of this section:

a. *"Builder"* means the prime contractor that hires and coordinates building subcontractors or if there is no prime, the contractor that completes more than fifty percent of the total construction work performed on the building. Construction work includes, but is not limited to, foundation, framing, wiring, plumbing, and finishing work.

b. *"Designer"* means the architect, engineer, landscape architect, builder, interior designer or other person who performs the actual design work or under whose direct supervision and responsible charge the construction documents are prepared.

c. *"Public building"* means a building owned or operated by the state, a state agency, or a governmental subdivision, including but not limited to a city, county, or school district.

8. The director may report an architect, professional engineer, or landscape architect to the appropriate examining board if the director believes the person has engaged in fraudulent conduct in connection with an energy efficiency rating for a building. The director may report a builder to the division of labor, bureau of contractor registration, if the director believes the builder has engaged in fraudulent conduct in connection with an energy efficiency rating for a building.

473.41
Reserved.

473.42 Exit signs--standards.

The department shall adopt rules which require the use of compact fluorescent bulbs in exit signs at the time of replacement, but no later than July 1, 2001. Prior to the adoption of rules, the department shall promote, through educational materials, the use of compact fluorescent bulbs or lighting of greater efficiency in exit signs.

473.43
Reserved.

473.44 Plumbing products efficiency standards--penalty.

1. The department shall adopt rules which prescribe water use standards for each product classified as a covered product under this section. The standards adopted shall be designed to achieve the maximum efficiency of water use which the department determines is technologically and economically feasible. The department shall consult with the state building code commissioner, the Iowa department of public health, and the plumbing manufacturers' institute, and shall review all applicable provisions under chapter 103A and chapter 135 in establishing the standards.
2. A person who knowingly violates this section is subject to a civil penalty of not more than one hundred dollars for each violation. Local government subdivisions which enforce the standards adopted under this section may collect and utilize receipts from the penalties imposed for building code inspections and enforcement of this section.
3. For the purposes of this section, "*covered products*" means water closets, urinals, showerheads, lavatory faucets and replacement aerators, and kitchen faucets and replacement aerators.

CHAPTER 7D EXECUTIVE COUNCIL

7D.34 Energy conservation lease-purchase.

1. As used in this section:
 - a. "Energy conservation measure" means installation or modification of an installation in a building which is primarily intended to reduce energy consumption or allow the use of an alternative energy source, which may contain integral control and measurement devices.
 - b. "State agency" means a board, department, commission or authority of or acting on behalf of the state having the power to enter into contracts with or without the approval of the executive council to acquire property in its own name or in the name of the state. "State agency" does not mean the general assembly, the courts, the governor or a political subdivision of the state.
2. a. A state agency may, with the approval of the executive council, lease as lessee real and personal properties and facilities for use as or in connection with any energy conservation measure for which it may so acquire real and personal properties and facilities, upon the terms, conditions and considerations the official or officials having the authority with or without the approval of the executive council to commit the state agency to acquire real and personal property and facilities deem in the best interests of the state agency. A lease may include provisions for ultimate ownership by the state or by the state agency and may obligate the state agency to pay costs of maintenance, operation, insurance and taxes. The state agency shall pay the rentals and the additional costs from the annual appropriations for the state agency by the general assembly or from other funds legally available. The lessor of the properties or facilities may retain a security interest in them until title passes to the state or state agency. The security interest may be assigned or pledged by the lessor. In connection with the lease, the state agency may contract for a letter of credit, insurance or other security enhancement obligation with respect to its rental and other obligations and pay the cost from annual appropriations for such state agency by the general assembly or from other funds legally available. The security enhancement arrangement may contain customary terms and provisions, including reimbursement and acceleration if appropriate. This section is a complete and independent authorization and procedure for a state agency, with the approval of the executive council, to enter into a lease and related security enhancement arrangements and this section is not a qualification of any other powers which a state agency may possess, including those under chapter 262, and the authorization and powers granted under this section are not subject to the terms or requirements of any other provision of the Code.
- b. Before a state agency seeks approval of the executive council for leasing real or personal properties or facilities for use as or in connection with any energy conservation measure, the state agency shall have a comprehensive engineering analysis done on a building in which it seeks to improve the energy efficiency by an engineering firm approved by the department of natural resources through a competitive selection process and the engineering firm is subject to approval of the executive council. Provisions of this section shall only apply to energy conservation measures identified in the comprehensive engineering analysis.
- c. Before the executive council gives its approval for a state agency to lease real and personal properties or facilities for use as or in connection with any energy conservation measure, the executive council shall in conjunction with the department of natural resources and after review of the engineering analysis submitted by the state agency make a determination that the properties or facilities will result in energy cost savings to the state in an amount that results in the state recovering the cost of the properties or facilities within six years after the initial acquisition of the properties or facilities.

Appendix C

Equipment Service Lives

Recommended Economic Lifetimes of Various Mechanical Systems

EQUIPMENT ITEM	ECONOMIC LIFE (yrs)
absorption liquid chilling system	20
air compressors	20
air conditioner single package, air-cooled, hermetic	10
air conditioner with remote air-cooled condenser	10
air-cooled single package air conditioner, hermetic	10
air-cooled split system air conditioners	10
air handling units horizontal and vertical	20-25
air side equipment	20
boilers	20-25
burners	10
central station units	20
centrifugal chillers	20-30
centrifugal compressors, multistage	30
centrifugal compressors, single stage	20
centrifugal liquid chilling systems	20-30
chillers, absorption	20
chillers, reciprocating, up to 150 TR	12
chillers, reciprocating, 150 TR and up	14
coils, heating and cooling	indefinite
comm. air conditioners, remote a.c. condenser	10
comm. water-cooled conditioners, single package	10
compressors, reciprocating v/w, hermetic	12
compressors, reciprocating v/w, open	14
compressor units, vertical single-acting	30
condensers, evaporative, ammonia	20
condensers, evaporative	20
condensers, horizontal shell and tube, ammonia	20
condensers, horizontal shell and tube	20
condensers, remote air-cooled	12
condensing units, reciprocating v/w, hermetic	12
condensing units, reciprocating v/w, open	14
condensing units, vertical single-acting	30
controls, electric and pneumatic	20
cooling coils	indefinite
cooling towers, masonry fill	45
cooling towers, metal fill	15-20
cooling towers, wood fill	15-20
diesel engines	10-12
electric furnaces	10

continued

EQUIPMENT ITEM	ECONOMIC LIFE (yrs)
electric heating, add on.....	10
electric motors	20-25
evaporative condensers.....	20
evaporators, ammonia	30
evaporators, pinned coil, ammonia	20
evaporators, spiral pinned, ammonia.....	20
fans, backward curved (airfoil)	20
fans, coil multiple space conditions	20
fans, coil multiple space conditions	20
fan coil room conditions	20
fans, forward curved	20
fans, utility sets	20
float regulators, high pressure, ammonia.....	30
float regulators, low pressure, ammonia	30
furnaces, gas fired	10
furnaces, oil fired	10
gas fired furnaces	10
gasoline engines	10
heat pumps, single package, air-to-air.....	20*
heat pumps, single package, water-to-air	20*
heat pumps, split system, air-to-air	20*
hermetic year-round air conditioners	14
high pressure receivers.....	30
high pressure receivers, ammonia.....	30
horizontal shell and tube liquid chillers, ammonia.....	30
horizontal shell and tube condensers	30
horizontal shell and tube condensers, ammonia.....	30
induction room air units.....	indefinite
liquid chilling systems, centrifugal.....	20
liquid coolers, horizontal shell and tube	30
low temperature compressor units, recip. v/w, hermetic.....	12
low temperature compressor units, recip, v/w, open.....	14
multistage centrifugal compressors	30
multistage turbo compressors.....	20
multizone central station units.....	20
multizone rooftop units.....	10
multiple space fan coil units.....	20
oil fired furnaces	10
oil receivers.....	NA
packaged refrigeration units.....	12

continued

EQUIPMENT ITEM	ECONOMIC LIFE (yrs)
packaged terminal units.....	10
plug type, refrigeration units.....	12
produce storage units	12
product coolers	20
product coolers, ammonia	20
pumps, centrifugal	20-25
residential water-cooled conditioners, single package.....	10
remote air-cooled condenser	12
room air conditioners	8
room units	8
turbines (steam).....	10-30

Appendix D

Discount Factors Applicable to Iowa

Refer to:

NISTIR 85-3273-17 (Rev. 4/02) Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis – April 2002, Fuller, Sieglinde K., U.S. Department of Commerce, National Institute of Standards and Technology, April 2002. (Annual Supplement to NIST Handbook 135.)

NOTE: FEMP discount factors are to be used for all life cycle cost calculations (OMB factors are not to be used).

NISTIR 85-3273-17

ENERGY PRICE INDICES AND DISCOUNT FACTORS FOR LIFE-CYCLE COST ANALYSIS

Annual Supplement to NIST Handbook 135 and NBS Special Publication 709

April 1, 2002 to March 31, 2003

Data for the Federal Methodology for Life-Cycle Cost Analysis, Title 10, CFR, Part 436, Subpart A;
and for the Energy Conservation Mandatory Performance Standards for New
Federal Residential Buildings, Title 10, CFR, Part 435

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PART I: TABLES FOR FEDERAL LIFE-CYCLE COST ANALYSIS

A. Single Present Value and Uniform Present Value Factors for Non-Fuel Costs

Table A-1 presents the single present value (SPV) factors for finding the present value of future non-fuel, non-annually recurring costs, such as repair and replacement costs and salvage values. The formula for finding the present value (P) of a future cost occurring in year t (C) is the following:

$$P = C_t \times \frac{1}{(1+d)^t} = C_t \times SPV_t ,$$

where d = discount rate, and

t = number of time periods (years) between the present time and the time the cost is incurred.

Table A-2 presents uniform present value (UPV) factors for finding the present value of future non-fuel costs recurring annually, such as routine maintenance costs. The formula for finding the present value (P) of an annually recurring uniform cost (A) is the following:

$$P = A \times \frac{(1+d)^N - 1}{d (1+d)^N} = A \times UPV_N ,$$

where d = discount rate, and

N = number of time periods (years) over which A recurs.

Tables A-3(a,b,c) present modified uniform present value (UPV*) factors for finding the present value of annually recurring non-fuel costs, such as water costs, which are expected to change from year to year at a constant rate of change (or escalation rate) over the study period. The escalation rate can be positive or negative. The formula for finding the present value (P) of an annually recurring cost at base-date prices (A) changing at escalation rate e is the following:

$$P = A_0 \times \left(\frac{1+e}{1+d} \right)^N \left[1 - \left(\frac{1+e}{1+d} \right)^N \right] = A_0 \times UPV^*_N \quad (d \neq e)$$

or

$$P = A_0 \times N = A_0 \times UPV^*_N \quad (d = e)$$

where A = annually recurring cost at base-date prices,

d = discount rate,

e = escalation rate, and

N = number of time periods (years) over which A recurs.

Note: if the discount rate is expressed in real terms, i.e., net of general inflation, then the escalation rate must also be expressed in real terms. If the discount rate is expressed in nominal terms, i.e., including general inflation, then the escalation rate must also be expressed in nominal terms.

In tables A-1, A-2, and A-3(a,b,c) SPV, UPV, and UPV* factors are provided for both the DOE and the OMB Circular A-94 real discount rates current as of the date of this publication. The FEMP SPV, UPV, and UPV* factors were computed using the DOE discount rate. The FEMP factors are for finding the present value of future costs associated with federal energy and water conservation projects and renewable energy projects. The OMB SPV, UPV, and UPV* factors were computed using the OMB discount rate. The OMB factors are for finding the present value of future costs associated with most other federal projects (except those specifically exempted from OMB Circular A-94). The DOE and OMB discount rates used in computing these tables are *real* rates, exclusive of general price inflation. Thus the resulting discount factors are intended for use with future costs that are stated in *constant* dollars.

NOTE: We have added to table A-3a a column of UPV* factors that incorporate an escalation rate of -2.3%, the negative of the inflation rate used to calculate the DOE nominal discount rate for 2002. The UPV* factors in this column can be used to calculate present values of fixed dollar amounts when performing a constant-dollar analysis. An example might be a fixed contract payment in an ESPC project. For these fixed amounts, the assumption that in a constant-dollar analysis all cash flows change at the rate of general inflation (so that the differential escalation rate is zero) does not apply. In real terms, fixed amounts change at a differential rate equal to the negative of the inflation rate.

Examples of How to Use the Factors:

SPV (FEMP): To compute the present value of a replacement cost expected to occur in the 8th year for an energy efficient heating system, go to Table A-1, find the 3.2% SPV factor for year 8 (0.777), and multiply the factor by the replacement cost as of the base date.

UPV (FEMP): To compute the present value of an annually recurring maintenance cost for a renewable energy system over 20 years, go to Table A-2, find the 3.2% UPV factor for 20 years (14.61), and multiply the factor by the annual maintenance cost as of the base date.

For further explanation and illustration of how to use these factors, see NIST Handbook 135.

Table A-1. SPV factors for finding the present value of future single costs (non-fuel)

Single Present Value (SPV) Factors			
Number of years from base date	DOE Discount rate 3.20%	OMB Discount Rates	
		Short term 3.00%	Long Term 3.90%
0.25	0.992	0.993	0.990
0.5	0.984	0.985	0.981
0.75	0.977	0.978	0.972
1	0.969	0.971	0.962
2	0.939	0.943	0.926
3	0.910	0.915	0.892
4	0.882	0.888	0.858
5	0.854	0.863	0.826
6	0.828	0.837	0.795
7	0.802	0.813	0.765
8	0.777	0.789	0.736
9	0.753	0.766	0.709
10	0.730	0.744	0.682
11	0.707		0.656
12	0.685		0.632
13	0.664		0.608
14	0.643		0.585
15	0.623		0.563
16	0.604		0.542
17	0.585		0.522
18	0.567		0.502
19	0.550		0.483
20	0.533		0.465
21	0.516		0.448
22	0.500		0.431
23	0.485		0.415
24	0.470		0.399
25	0.455		0.384
26	0.441		0.370
27	0.427		0.356
28	0.414		0.343
29	0.401		0.330
30	0.389		0.317

Table A-2. UPV factors for finding the present value of annually recurring uniform costs (non-fuel)

Uniform Present Value (UPV) Factors			
Number of years from base date	DOE	OMB Discount Rates, a	
	Discount rate 3.20%	Short term, b 3.00%	Long Term, c 3.90%
1	0.97	0.97	0.96
2	1.91	1.91	1.89
3	2.82	2.83	2.78
4	3.70	3.72	3.64
5	4.55	4.58	4.46
6	5.38	5.42	5.26
7	6.18	6.23	6.02
8	6.96	7.02	6.76
9	7.71	7.79	7.47
10	8.44	8.53	8.15
11	9.15		8.81
12	9.84		9.44
13	10.50		10.05
14	11.14		10.63
15	11.77		11.20
16	12.37		11.74
17	12.96		12.26
18	13.52		12.76
19	14.07		13.25
20	14.61		13.71
21	15.12		14.16
22	15.62		14.59
23	16.11		15.01
24	16.58		15.40
25	17.03		15.79
26	17.47		16.16
27	17.90		16.51
28	18.31		16.86
29	18.71		17.19
30	19.10		17.50

B. Modified Uniform Present Value Factors for Fuel Costs

This section presents FEMP and OMB modified uniform present value (UPV*) discount factors for calculating the present value of energy usage for federal projects. Factors are provided for the four major Census regions and for the overall United States. The factors are modified in the sense that they incorporate energy price escalation rates based on future energy prices projected by DOE for the years 2002-2032. There are two sets of UPV* tables: the "Ba" tables present FEMP UPV* factors based on the DOE discount rate (3.2% real), and the "Bb" tables present OMB UPV* factors based on two OMB discount rates (3.0% real for short-term study periods of 1 to 10 years, 3.9% real for long-term study periods of 11 to 30 years). The underlying energy price indices for the years 2002 to 2032 on which these UPV* calculations are based are shown in tables Ca-1 through Ca-5. The corresponding average energy price escalation rates for selected time intervals between 2002 and 2032 are shown in tables Cb-1 through Cb-5.

Energy Price Projections

The FEMP and OMB UPV* factors incorporate energy price escalation rates computed from future energy prices projected by the Energy Information Administration (EIA) of the U.S. Department of Energy. Energy prices through 2020 were generated by EIA using the National Energy Modeling System (NEMS) and published in the *Annual Energy Outlook 2002*¹ (AEO2002). At the request of FEMP, EIA extrapolated energy prices after the year 2020 from the AEO2002 data.

NEMS is an energy market model designed to project the impacts of alternative energy policies or assumptions on U.S. energy markets. NEMS produces projections of the U.S. energy future, given current laws and policies and other key assumptions, including macroeconomic indicators from Data Resources, Inc., the production policy of the Organization of Petroleum Exporting Countries, the size of the economically recoverable resource base for fossil fuels, and the rate of development and penetration of new technologies. NEMS balances energy supply and demands with modules representing primary fuel supply, end-use demand for four sectors, and conversion of energy by refineries and electricity generators. Macroeconomic and international oil modules reflect the impacts of energy prices, production, and consumption on world oil markets and the economy.

In order to produce price projections to 2032, EIA extrapolated the prices from the AEO2002 with specific assumptions about long-term trends. To provide long-term price expectations to the post-2020 projections, world oil price expectations through 2050 were calculated using assumptions of world oil supply and demand. These expectations were used as the basis for the 2032 projections of petroleum product prices, using the implied 2020 refinery markups to calculate the regional end-use prices.

The EIA energy price projections presented in this report, like those of other forecasters, are dependent on the data, methodologies, and specific assumptions used in their development. Many

¹ Energy Information Administration, *Annual Energy Outlook 2002*, DOE/EIA-0383(2002), December 2001.

of the assumptions concerning the future cannot be known with any degree of certainty. Thus, the projections are not statements of what will happen, but what might happen given the particular assumptions and methodologies used. Although EIA has endeavored to make these forecasts as objective, reliable, and useful as possible, these projections should serve as an adjunct to, not a substitute for, the analytical process. The *AEO2002* was prepared by EIA as required under statute by federal legislation. The price projections to 2032 were prepared in accordance with a Service Request from the Federal Energy Management Program.

UPV* Calculation Method

The formula for finding the present value (P) of future energy costs or savings is the following:

$$P = A_0 \times \sum_{t=1}^N \frac{I_{(2001+t)}}{(1+d)^t} = A_0 \times UPV^*_N$$

where A = annual cost of energy as of the base date (April 1, 2002);
 t = index used to designate the year of energy usage;
 N = number of periods, e.g., years, over which energy costs or savings accrue;
 $I_{(2002+t)}$ = projected average fuel price index² given in Tables Ca-1 through Ca-5 for the year 2002+t (where $I_{2002} = 1.00$); and
 d = the real discount rate.

This formula is based on end-of-year energy prices and end-of-year discounting. Note that annual energy costs as of the base date of the LCC analysis (A_0 , to be supplied by the analyst) should reflect the current energy price schedule as of that date, which may not be the same as the energy price itself on that date.³ That is, the annual energy cost should reflect summer-winter rate differences, time-of-use rates, block rates considerations, and demand charges (as appropriate) anticipated to be in effect that year. If energy and demand costs are calculated separately (as is sometimes done for electricity), the UPV* factor should be applied to both costs.

The data in the tables that follow are reported for the four Census regions and the U.S. average. Figure B-1 presents a map showing the states corresponding to the four Census regions. The Census regions do not include American Samoa, Canal Zone, Guam, Puerto Rico, Trust Territory of the Pacific Islands, or the Virgin Islands. Analysts of federal projects in these areas should use data that are "reasonable under the circumstances," and may refer to the tables with U.S. average data for guidance.

² For greater precision, the UPV* factors reported in the Ba and Bb tables were computed using the unrounded form of the indices given in Tables Ca-1 through Ca-5.

³ While the UPV* factors provided in this publication were computed using energy price indices that correspond to energy prices as of April 1 in the current and future years, the analyst is encouraged to use for determining A the energy prices prevailing as of the base date of the LCC analysis for the project evaluated.

B.1. FEMP Modified Uniform Present Value Factors

The FEMP Modified Uniform Present Value (FEMP UPV*) factors presented in the "Ba" tables, based on the current DOE discount rate (3.2%), are for calculating the present value of energy costs or savings accruing over 1 to 25 years and are to be used in life-cycle cost analyses of federal energy conservation and renewable energy projects. Factors are reported in the "Ba" tables for 30 years to accommodate a planning/design/construction period of up to 5 years. (See "Examples of How to Use FEMP UPV Factors" below for instructions on use with planning/design/construction periods.)

These factors apply only to annual energy usage or energy savings that are assumed to be the same each year over the service period. The NIST BLCC computer program can compute the present value of energy usage and savings which are not the same in each year.

Examples of How to Use the FEMP UPV* Factors:

FEMP UPV*, no planning/design/construction period: To compute the present value of heating with natural gas over 25 years in a federal office building in New Mexico, go to Table Ba-4, find the FEMP UPV factor for commercial natural gas for 25 years (16.98), and multiply this factor by the annual heating cost at base-date natural gas prices.

FEMP UPV*, with planning/design/construction period: To compute a present value factor for a service period following a planning/design/construction period (1) find the FEMP UPV* factor for the combined length of the planning/design/construction period and the service period (not to exceed 30 years), and (2) subtract from (1) the FEMP UPV* factor for the planning/design/construction period alone. The difference is the FEMP UPV* factor for the years over which energy costs or savings actually accrue. For example, suppose a new federal office building in New York is being evaluated with several energy conserving design options. It is expected to have a planning/design/construction period of 5 years, after which it will be occupied for at least 25 years. To compute the present value of natural gas costs over 25 years of occupancy, go to Table Ba-1 and find the FEMP UPV* factors for commercial natural gas for 5 years (4.42) and for 30 years (19.57). The difference (15.15) is the FEMP UPV* factor for natural gas costs over 25 years, beginning 5 years after the base date. Multiply 15.15 by the annual natural gas cost at base-date prices (not occupancy-date prices) to calculate the present value of natural gas costs over the entire 25-year occupancy period.

Table Ba-2. FEMP UPV* Discount Factors adjusted for fuel price escalation, by end-use sector and fuel type.

Discount Rate = 3.2 percent (DOE)

Census Region 2 (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin)

N	RESIDENTIAL				COMMERCIAL					INDUSTRIAL					TRANSPORT	N
	Elec	Dist	LPG	NtGas	Elec	Dist	Resid	NtGas	Coal	Elec	Dist	Resid	NtGas	Coal	GasIn	
-	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-
1	0.94	0.88	0.97	0.92	0.97	0.92	0.94	0.92	0.96	0.97	0.93	0.94	0.92	0.95	0.93	1
2	1.84	1.72	1.92	1.85	1.90	1.80	1.86	1.84	1.88	1.92	1.82	1.86	1.89	1.85	1.83	2
3	2.71	2.53	2.85	2.75	2.81	2.66	2.76	2.74	2.76	2.84	2.69	2.75	2.85	2.74	2.71	3
4	3.55	3.31	3.74	3.62	3.67	3.49	3.63	3.62	3.60	3.72	3.53	3.62	3.79	3.58	3.58	4
5	4.38	4.08	4.61	4.46	4.50	4.30	4.48	4.46	4.42	4.56	4.35	4.47	4.70	4.39	4.42	5
6	5.17	4.83	5.46	5.28	5.29	5.10	5.31	5.27	5.19	5.39	5.16	5.30	5.60	5.18	5.24	6
7	5.94	5.56	6.28	6.07	6.07	5.88	6.12	6.06	5.94	6.18	5.95	6.11	6.48	5.93	6.03	7
8	6.69	6.29	7.09	6.83	6.82	6.67	6.91	6.82	6.66	6.96	6.74	6.89	7.34	6.65	6.80	8
9	7.42	7.01	7.87	7.57	7.55	7.44	7.68	7.57	7.36	7.72	7.51	7.66	8.18	7.35	7.55	9
10	8.12	7.70	8.65	8.30	8.26	8.19	8.43	8.29	8.04	8.47	8.27	8.41	9.01	8.03	8.27	10
11	8.81	8.39	9.40	9.00	8.96	8.95	9.16	9.00	8.68	9.19	9.02	9.13	9.82	8.68	8.97	11
12	9.47	9.08	10.13	9.69	9.64	9.70	9.87	9.69	9.31	9.90	9.78	9.84	10.62	9.30	9.65	12
13	10.10	9.76	10.84	10.35	10.29	10.46	10.57	10.36	9.90	10.58	10.53	10.54	11.39	9.90	10.31	13
14	10.72	10.43	11.53	11.00	10.92	11.20	11.24	11.01	10.48	11.25	11.27	11.21	12.15	10.48	10.94	14
15	11.32	11.08	12.21	11.63	11.53	11.93	11.90	11.64	11.03	11.90	12.00	11.87	12.90	11.04	11.56	15
16	11.90	11.72	12.86	12.25	12.14	12.63	12.55	12.26	11.56	12.54	12.70	12.51	13.62	11.58	12.16	16
17	12.47	12.33	13.50	12.84	12.72	13.32	13.17	12.87	12.07	13.16	13.38	13.13	14.33	12.09	12.74	17
18	13.02	12.93	14.12	13.43	13.29	13.99	13.79	13.45	12.56	13.76	14.05	13.74	15.02	12.59	13.30	18
19	13.56	13.52	14.72	13.99	13.84	14.65	14.38	14.03	13.04	14.36	14.70	14.33	15.71	13.07	13.85	19
20	14.08	14.09	15.31	14.55	14.37	15.29	14.96	14.59	13.50	14.93	15.33	14.91	16.37	13.53	14.38	20
21	14.58	14.64	15.88	15.09	14.90	15.91	15.53	15.14	13.94	15.49	15.94	15.47	17.03	13.97	14.89	21
22	15.07	15.18	16.43	15.61	15.40	16.51	16.08	15.67	14.36	16.04	16.54	16.02	17.67	14.40	15.39	22
23	15.54	15.70	16.96	16.13	15.89	17.10	16.62	16.20	14.77	16.58	17.12	16.56	18.29	14.82	15.88	23
24	16.00	16.20	17.48	16.63	16.37	17.67	17.15	16.71	15.17	17.10	17.69	17.08	18.91	15.22	16.35	24
25	16.45	16.70	17.99	17.12	16.84	18.22	17.66	17.21	15.56	17.61	18.24	17.59	19.51	15.61	16.81	25
26	16.88	17.18	18.48	17.60	17.29	18.76	18.16	17.69	15.93	18.10	18.77	18.09	20.10	15.98	17.25	26
27	17.30	17.64	18.95	18.07	17.73	19.28	18.65	18.17	16.29	18.59	19.29	18.58	20.67	16.35	17.68	27
28	17.71	18.09	19.42	18.52	18.16	19.80	19.13	18.63	16.64	19.06	19.79	19.05	21.24	16.70	18.10	28
29	18.10	18.53	19.86	18.97	18.58	20.29	19.59	19.09	16.98	19.52	20.29	19.51	21.79	17.05	18.51	29
30	18.48	18.96	20.30	19.40	18.99	20.77	20.05	19.53	17.31	19.97	20.76	19.96	22.33	17.38	18.90	30

Note: UPV* factors are reported for years 26-30 to accommodate a planning/construction period of up to 5 years.
(See p. 14 for instructions on use; page xiii for abbreviations.)