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Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis – 2024

Annual Supplement to NIST Handbook 135

Joshua D. Kneifel
Priya D. Lavappa

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Abstract

This is the 2024 edition of energy price indices and discount factors for performing life-cycle cost analyses of energy and water conservation and renewable energy projects in federal facilities. It will be effective from the publication date to the publication of the 2025 edition. This publication supports the federal life cycle costing methodology described in 10 CFR 436A and OMB Circular A-94 by updating the energy price projections and discount factors that are described, explained, and illustrated in NIST Handbook 135 (HB 135, Life-Cycle Costing Manual for the Federal Energy Management Program).

Keywords

Building economics; Life cycle cost analysis; Energy efficiency, Renewable energy.

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Foreword

This is the 2024 Annual Supplement to NIST Handbook 135, Life-Cycle Costing Manual for the Federal Energy Management Program (FEMP) [1]. The annual supplement provides energy price indices and discount factors for use with the FEMP procedures for life-cycle cost analysis, as established by the U.S. Department of Energy (DOE) in Subpart A of Part 436 of Title 10 of the Code of Federal Regulations (10 CFR 436A) [2] and amplified in NIST Handbook 135. These indices and factors are provided as an aid to implementing life-cycle cost evaluations of potential energy and water conservation and renewable energy investments in existing and new federally owned and leased buildings.

The price indices and discount factors are calculated with the most recent energy price projections from DOE's Energy Information Administration (EIA) Annual Energy Outlook (AEO) [3] (https://www.eia.gov/outlooks/aeo/) and the most recent discount rates from FEMP and the Office of Management and Budget (OMB) Circular A-94 [4]. This issue of the Annual Supplement is intended for use until the publication of the 2025 edition. The updated edition of NIST's Building Life-Cycle Cost (BLCC) and Energy Escalation Rate Calculator (EERC) programs are released at the same time as this Annual Supplement, for use over the same time period. The software products are discussed below.

Along with the final data tables, the EIA energy price projections underlying this Annual Supplement have been made available by NIST. The Annual Supplement and the associate data table spreadsheet are available at https://www.energy.gov/femp/building-life-cycle-cost-programs. The data tables are also available at this DOI: https://doi.org/10.18434/mds2-3194.

The life cycle costing methods and procedures, as set forth in 10 CFR 436A, are to be followed by all federal agencies, unless specifically exempted, for evaluating the cost effectiveness of potential energy and water conservation and renewable energy investments in federally owned and leased buildings. For most other federal LCC analyses OMB Circular A-94 provides the relevant guidelines.

As called for by legislation (Energy Policy and Conservation Act, P.L.94-163, 1975, 92 Stat 3206, 42 USC 8252 et seq) [5], NIST has provided technical assistance to the U.S. DOE in the development and implementation of life-cycle costing methods and procedures. The following publications and software products provide the methods, data, and computational tools for federal life-cycle cost analysis:

(1) *Life-Cycle Costing Manual for the Federal Energy Management Program*, National Institute of Standards and Technology, Handbook 135 – 2022 edition.

This manual is a guide to understanding life cycle costing and related methods of economic analysis as they are applied to federal decisions, especially those subject to 10 CFR 436A rules. It describes the required procedures and assumptions, defines and explains how to apply and interpret economic performance measures, gives examples of federal decision problems and their solutions, explains how to use energy price indices and discount factors, and provides computational aids and instructions for calculating the required measures. The 2020 edition broadened the scope of consideration to include federal sustainability and resilience projects.

The 2022 edition expanded discussion on pricing externalities, specifically greenhouse gas (GHG) emissions.

(2) *Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis, Annual Supplement to NIST Handbook 135*, National Institute of Standards and Technology, NISTIR 85-3273.

This report, which is updated annually, provides the current DOE and OMB discount rates, projected energy price indices, and corresponding discount factors needed to estimate the present values of future energy and non-energy-related project costs. The 2022 edition was restructured to provide a report with the data tables available in a supplemental spreadsheet.

(3) *BLCC 5.3-22, NIST Building Life-Cycle Cost.* This program uses as default values the same discount factors and energy price projections that underlie the discount factor tables in the Annual Supplement. It is recompiled annually and available for Windows.

BLCC 5.3 provides comprehensive economic analysis capabilities for the evaluation of proposed capital investments that are expected to reduce the long-term operating costs of buildings and building systems. It computes the LCC for project alternatives, compares project alternatives to determine which has the lowest LCC, performs annual cash flow analysis, and computes net savings (NS), savings-to-investment ratio (SIR), and adjusted internal rate of return (AIRR) for project alternatives over their designated study period. The BLCC program can be used to perform economic analysis of capital investment projects undertaken by federal, state, and local government agencies. In the application to federal energy efficiency, water conservation, and renewable energy projects, BLCC5 is consistent with NIST Handbook 135, and the federal life-cycle cost methodology and procedures described in 10 CFR 436A and OMB Circular A-94.

BLCC 5.3 has six modules, all of them consistent with the life-cycle cost methodology of 10 CFR 436A, but programmed to include default inputs and nomenclature for specific uses:

- **FEMP Analysis, Energy Project**

  for energy and water conservation and renewable energy projects under the FEMP rules, agency-funded;

- **Federal Analysis, Financed Project**

  for federal projects financed through Energy Savings Performance Contracts (ESPC) or Utility Energy Services Contracts (UESC) as authorized by Executive Order 13123 (6/99);

- **OMB Analysis, Federal Analysis, Projects subject to OMB Circular A-94**

  for projects subject to OMB Circular A-94 (most other, non-energy, federal government construction projects, but not water resource projects);

- **MILCON Analysis, Energy Project**

  for energy and water conservation and renewable energy projects in military construction, agency-funded;

- **MILCON Analysis, ECIP Project**

  for energy and water conservation projects under the Energy Conservation Investment Program (ECIP) – renamed Energy Resilience Conservation Investment Program (ERCIP) in 2021;

- **MILCON Analysis, Non-Energy Project**

  for military construction designs that are not primarily for energy or water conservation.

(4) *EERC, Energy Escalation Rate Calculator*, a program that computes an average rate of escalation for a specified time period, which can be used as an escalation rate for contract payments in Energy Savings Performance Contracts (ESPC) and Utility Energy Services Contracts (UESC). Escalation rates can be computed based on the EIA energy price projections used for calculating the FEMP discount factors and on EIA projections adjusted by NIST for potential carbon pricing. EERC is available as a web interface at https://pages.nist.gov/eerc/ and no longer available as a downloadable application.

The latest versions of the programs and publications described above can be downloaded from the DOE/FEMP web site at https://www.energy.gov/femp/building-life-cycle-cost-programs.

In 2014, DOE and NIST developed a 5.5 hour continuing education course, "Fundamentals of Life Cycle Costing for Energy Conservation" that introduced the elements of life-cycle cost analysis of energy and water conservation projects was available at the Whole Building Design Guide (WBDG) website at http://www.wbdg.org/education/femp19.php. However, starting in 2021 the training course is no longer accessible due to web browsers no longer supporting the software on which the training was built (Flash). For in-house training, FEMP-Qualified Instructors are available to conduct LCC workshops on their own account across the United States. For a list of instructors' email or the content of the LCC training course (presentation slides), please email Joshua Kneifel at joshua.kneifel@nist.gov.

For further information on the Federal Energy Management Program, please visit https://www.energy.gov/femp/building-life-cycle-cost-programs.

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1. Introduction

This report provides tables of present-value factors for use in the life-cycle cost analysis of capital investment projects for federal facilities, including energy efficiency, water conservation, sustainability, and resilience. It also provides energy price indices based on Department of Energy (DOE) forecasts from 2023 to 2050. The factors and indices presented in this report are useful for determining the present value of future project-related costs, especially those related to operational energy costs. Discount factors included in this report are based on two different federal sources: (1) the DOE discount rate for projects related to energy conservation, renewable energy resources, and water conservation; and (2) Office of Management and Budget (OMB) discount rates from Circular A-94 for use with most other capital investment projects in federal facilities.

The DOE discount and inflation rates for 2023 are as follows:

Real rate (excluding general price inflation):	3.0 %
Nominal rate (including general price inflation):	4.2 %
Implied long-term average rate of inflation:	1.2 %

The DOE nominal discount rate is based on long-term Treasury bond rates averaged in the previous year (2023). The nominal, or market, rate is converted to a real rate to correspond with the constant-dollar analysis approach used in most federal life-cycle cost (LCC) analyses. The method for calculating the real discount rate from the nominal discount rate is described in 10 CFR 436 and uses the 10-year simple average projected rates of general inflation published in the most recent Report of the President's Economic Advisors, Analytical Perspectives (2.9 % for 2024).[1] The procedure would result in a real discount rate for 2024 of 1.3 %, which is lower than the 3.0 % floor prescribed in 10 CFR 436.

Thus the 3.0 % floor is used as the real discount rate for FEMP analyses in 2024. The implied long-term average rate of inflation based on the real discount rate (3.0 %) and nominal discount rate (4.2 %) was calculated as 1.2 %. Federal agencies and contractors to federal agencies are required by 10 CFR 436 to use the DOE discount rates when conducting LCC analyses related to energy conservation, renewable energy resources, and water conservation projects for federal facilities.

The nominal and real discount rates applicable to general (non-energy or water) capital investments are published annually in OMB Circular A-94, Appendix C.[2] OMB has specified two basic types of discount rates: (1) a discount rate for public investment and regulatory analyses; and (2) a discount rate for cost-effectiveness, lease-purchase, and related analyses. Only discount rates for the second type of analyses are included in this Annual Supplement, since the primary purpose of this report is to support cost-effectiveness studies related to the design and operation of federal facilities.

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[1] The long-run general rate of inflation is a constant value used over the entire study period. Therefore, it does not account for short-term variability in inflation such as that realized during and after the COVID-19 pandemic.
[2] The most recent Appendix C was released in December 2023 at the time of publication.

OMB discount rates for cost-effectiveness and lease-purchase studies are based on interest rates on Treasury Notes and Bonds with maturities ranging from 3 years to 30 years. Currently six maturities have been specifically identified by OMB, and are shown here with the corresponding real interest rate to be used as the discount rate for studies subject to OMB Circular A-94 Appendix C (as of December 2023):

Maturity:	3-year	5-year	7-year	10-year	20-year	30-year
Rate:	1.2 %	1.3 %	1.4 %	1.5 %	2.0 %	2.0 %

OMB suggests that the actual discount rate for an economic analysis be interpolated from these maturities and rates, based on the study period used in the analysis. Due to limitations on the size of this Annual Supplement, discount factors for only two of these maturities are presented in the data tables: factors for short term analyses (up to 10 years) based on the 7-year real rate (1.4 %), and factors for long-term analyses (longer than 10 years) based on the 30-year real rate (2.0 %). As a result, these discount factors are for approximation purposes only. It is suggested that the NIST Building Life Cycle Cost (BLCC) program be used to compute the present value factors for the discount rate corresponding to the length of the study period when approximate values are not satisfactory for the project analysis. (See preface for details on obtaining this program.)

The energy price indices and corresponding present value factors published in this report are computed from energy price forecasts from the DOE's Energy Information Administration (EIA) for the Reference Case of the AEO. The EIA energy price forecast used in this report was the most recent available at the time this report was prepared. A description of the methodology used by EIA to project energy prices through 2050 is included in section B of this report. DOE has not projected escalation rates for water prices to be used in the LCC analysis of water conservation projects. FEMP recommends estimating water escalation rates based on the following options (in order or preference): (1) local water utility forecasts, (2) historical rate data (with caps), and historical consumer price index data. The FEMP guidance on utility rate estimation is available at the following link: https://www.energy.gov/femp/articles/guidance-utility-rate-estimations-and-weather-normalization-performance-contracts [6].

Federal agencies and contractors to federal agencies are encouraged to seek energy price projections from their local utility to use in place of the DOE/EIA projections, especially when evaluating alternative fuel types. In such cases the BLCC program can be used to calculate appropriate "modified uniform present value" (UPV*) factors for use in the LCC analysis of federal capital energy efficiency, water conservation, or renewable resource projects. Otherwise, 10 CFR 436 requires the use of the DOE energy price forecasts when conducting LCC analyses of such projects. The UPV* factors for energy costs presented in this report have been precalculated with the DOE forecast data. Thus, the use of these UPV* factors automatically ensures that the DOE forecast data have been included in the analysis.

Most financed federal projects, such as Energy Savings Performance Contracts (ESPC), base contract payments on projected annual energy cost savings. When setting up the contract, average rates of energy price escalation over the contract term are a matter of negotiation.

One consideration in setting escalation rates is the potential for internalizing externalities into energy prices, such as impacts of greenhouse gases (GHGs) emissions on climate change. Thus in 2010 FEMP introduced a new "D" series of tables to the Annual Supplement that project potential future carbon prices and electricity-related carbon emissions rates under a range of carbon policy scenarios based on proposed federal cap-and-trade legislation.[3] In 2021, federal agencies were directed to consider the social cost of GHG emissions into decision-making. Therefore, in 2022, the methodology developed in 2010 was replaced with social cost of greenhouse gas (GHG) and electricity grid projections using the Interagency Working Group on Social Cost of Greenhouse Gases Interim Estimates under Executive Order 13990 [7] and emissions projections from the most recent release (currently 2023) of the Cambium database [8]. This methodology is combined with projected energy prices to develop average energy price escalation rates that include the social cost of carbon. The Energy Escalation Rate Calculator (EERC), a BLCC companion program for financed projects, calculates these average escalation rate using three assumed carbon cost estimates. These may be considered by federal agencies for use as energy price escalation rates for contract payments. Further guidance on implementation is forthcoming.

All the tables of discount factors provided with this report are based on real discount rates and are therefore intended for use only with economic analyses conducted in constant dollars (in which the purchasing power of the dollar is held constant). The energy price escalation rates and corresponding energy price indices for federal analyses contained in this report are also expressed in real terms. If nominal discount rates and current dollar costs (which both include inflation) are used in the LCC analyses of federal projects, choose the current-dollar-analysis option in the BLCC computer program, which uses a nominal discount rate and adds the rate of general inflation to all dollar amounts.

This report uses the term "present value" instead of "present worth" for the discount factors presented. The meaning of these two terms is considered identical for purposes of economic analysis. This change in terminology was made to be consistent with the terms used in the ASTM International compilation of standards on building economics [9].

In all tables, the "end-of-year" discounting convention is used, that is, all factors and indices are computed to adjust future dollar amounts to present value from the end of the year in which they are expected to occur. The factors and indices in this publication which include energy price escalation rates (e.g., UPV* factors and energy price indices) were calculated using January 2024 as their base date. However, these factors and indices can be used without adjustment for the LCC analysis of projects with other base dates until the release of the next revision of this publication. Adjustment of these factors and indices for differences in the month-specific base date is not generally warranted due to uncertainties in estimating future energy prices.

Starting in the 2022 edition of this document, the tables and ENCOST data are provided in a supplemental spreadsheet (NISTIR85-3273-XX.xlsx) available for download with this document.

[3] Details on this approach are available in Section D of this document.

Starting in the 2023 edition of this document, the sections and associated table nomenclature changed to align with NIST's newest technical publication formatting requirements. Section headings have changed from roman numeral to numerical. Subsection headings have changed from alphanumerical to numerical. For example, Part I B-2 becomes Section 2.2.2.

Starting the 2024 edition of this document, additional data has been provided at the nine Census divisions to provide greater granularity than that found at the four Census regions. The Census division level data has been incorporated into both EERC and BLCC. The expectation is that future releases of this document will transition to providing solely Census Division level data.

2. Tables for Federal Life-Cycle Cost Analysis

This section provides the data tables (see associated spreadsheet) for federal life-cycle cost analysis, the underlying formulas for calculating the values in those tables, and examples showing how to use the data tables.

2.1. 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_t) 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_0) changing at escalation rate e is the following:

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

or

$$P = A_0 \times N = A \times UPV^*_N \qquad (d = e),$$

where A_0 = *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 rates. 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 -1.2 %, the negative of the inflation rate used to calculate the DOE nominal discount rate for 2024. 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 3.0 % SPV factor for year 8 (0.789), and multiply the factor by the replacement cost as of the base date.

SPV (OMB, Short-term): To compute the present value of a repair cost in the 5th year for a floor covering (non-energy related), go to Table A-1, find the 1.4 % SPV factor for year 5 (0.933), and multiply the factor by the repair cost as of the base date.

SPV (OMB, Long-term): To compute the present value of a repair cost in the 15th year for a floor covering (non-energy related), go to Table A-1, find the 2.0 % SPV factor for year 15 (0.743), and multiply the factor by the repair 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 3.0 % UPV factor for 20 years (14.877), and multiply the factor by the annual maintenance cost as of the base date.

UPV (OMB, Short-term): To compute the present value of annually recurring costs of office cleaning over 10 years (for a project not primarily related to energy conservation), go to Table A-2, find the 1.4 % UPV factor for 10 years (9.271), and multiply the factor by the annual cleaning cost as of the base date.

UPV (OMB, Long-term): To compute the present value of annually recurring costs of office cleaning over 25 years (for a project not primarily related to energy conservation), go to Table A-2, find the 2.0 % UPV factor for 25 years (19.523), and multiply the factor by the annual cleaning cost as of the base date.

UPV* (all): To compute the present value of annually recurring costs of water usage which are expected to increase at 2.0 % faster than the rate of general inflation over 25 years, find the UPV* factor from table A-3 (a, b, or c as appropriate) that corresponds to 2% escalation and a 25-year study period. From table A-3a (3.0 % DOE discount rate) the corresponding UPV* factor is 22.08. Multiply this factor by the annual water cost as computed at base year prices to determine the present value of these water costs over the entire 25 years.

UPV* (negative inflation rate): To compute the present value of an annually recurring contract payment that is fixed over a contract period of 10 years, find the UPV* factor from table A-3a that corresponds to an escalation of 1.0 % and a 10-year time period. From table A-3a (3.0 % DOE discount rate) the corresponding UPV* factor is 8.99. Multiply this factor by the annual contract payment as of the base year to determine the present value of these contract payments over the entire 10-year period.

Note: UPV factors are generally applied to costs that recur annually in substantially the same amount. Examples of such costs are routine operating and maintenance costs. UPV factors are generally applied to costs that recur annually but change from year to year at a constant escalation rate. Examples of such costs are water usage costs when they increase from year to year. These costs usually occur every year over the service period of the building life. If there is a planning/design/construction period before the service life begins, during which these annual costs are not incurred, the appropriate UPV (or UPV*) factor for the service period is the difference between the UPV (or UPV*) factor for the entire study period and the UPV (or UPV*) factor for the planning/design/construction period. For example, if the planning/ design/construction period is 3 years and the service period is 25 years, for a total study period of 28 years, the corresponding UPV factor (from Table A-2, DOE 3.0 % discount rate) is 18.764 – 2.829 =15.935.*

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

2.2. 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 2024 to 2054. There are two sets of UPV* tables: the "Ba" tables present FEMP UPV* factors based on the DOE discount rate (3.0 % real), and the "Bb" tables present OMB UPV* factors based on two OMB discount rates (1.4 % real for short-term study periods of 1 to 10 years, 2.0 % real for long-term study periods of 11 to 30 years). The underlying energy price indices for the years 2024 to 2054, 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 2024 and 2054 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 EIA. Energy prices through 2050 were generated by EIA using the National Energy Modeling System (NEMS) and published in the AEO2023 [3]. Note that AEO 2023 has been used because no AEO is being released in 2024. The projection period for the AEO2023 projections is through 2050«ForecastYearEnd». Any years beyond the EIA projections are extrapolated assuming escalation equivalent to the simple average of the last 5 years of EIA projections (2046 through 2050).

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.

The EIA energy price projections presented in this report, like those of other forecasts, are dependent on the data, methodologies, and specific assumptions used in their development. Many 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 specific 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 AEO2023 was prepared by EIA as required under statute by federal legislation. The price projections to 2050 were prepared in accordance with a Service Request from the Federal Energy Management Program.

Note: Section 441 of the Energy Independence and Security Act of 2007 (EISA) extends from 25 years to 40 years the maximum service period for conducting FEMP life-cycle cost analyses. To account for the legislated change, the BLCC program now incorporates unofficial projections of future energy prices beyond 2050 to accommodate FEMP service periods of up to 40 years. The projections are based on simple average growth rate of the last 5 years of EIA projections. BLCC users should exercise caution when interpreting energy cost savings beyond 30 years and do sensitivity analyses to test different out-year assumptions.

UPV* Calculation Method. The formula for finding the present value (P) of future energy costs or savings is the following:

$$P = A_0 * \sum_{t=1}^{N} \frac{I_{(2024+t)}}{(1+d)^t} = A_0 * UPV_N^*$$

where A_0 = *annual cost of energy as of the base date (2024);*

t = *index used to designate the year of energy usage;*
N = *number of periods, e.g., years, over which energy costs or savings accrue;*
$I_{(2023+t)}$ = *projected average fuel price index*[4] *given in Tables Ca-1 through Ca-5 for the year 2024+t (where* I_{2024} *= 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.[5] 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 supplemental tables are reported for the four Census regions and the U.S. average. Additional tables have been provided that include indices and escalation rate data for both Census regions and divisions that are machine readable. Figure 1 presents a map showing the states corresponding to the four Census regions and nine Census divisions. The Census regions and divisions do not include American Samoa, Canal Zone, Guam, Puerto Rico, associated states and commonwealths in the Pacific Islands, or the U.S. 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.

[4] 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.

[5] While the UPV* factors provided in this publication were computed using energy price indices that correspond to energy prices as of April in the current and future years, the analyst is encouraged to use for determining A_0 the energy prices prevailing as of the base date of the LCC analysis for the project evaluated.

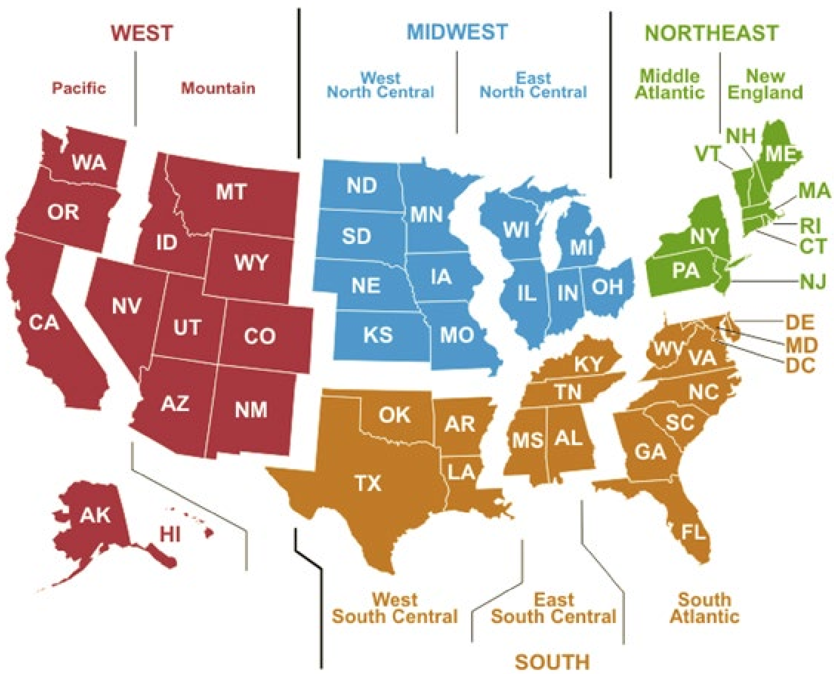

Fig. 1. Census Regions and Districts[6]

2.2.1. 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 (3.0 %), are for calculating the present value of energy costs or savings accruing over 1 year to 30 years and are to be used in life-cycle cost analyses of federal energy conservation and renewable energy projects. These factors may be applied to projects with or without planning/design/construction periods, as shown below.

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 BLCC computer program can compute the present value of energy usage and savings that 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 (17.07), 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, 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 accrue.

[6] Source: EIA - https://www.eia.gov/consumption/commercial/maps

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 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 (4.02) and for 30 years (16.82). The difference (12.80) is the FEMP UPV* factor for natural gas costs over 25 years, beginning 5 years after the base date. Multiply 12.80 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.

2.2.2. OMB Modified Uniform Present Value Factors

The OMB Modified Uniform Present Value (OMB UPV*) factors presented in the "Bb" tables, based on the current OMB discount rates (1.4 % short term and 2.0 % long term), are for calculating the present value of energy costs accruing over 1 year to 30 years when conducting a life-cycle cost analysis of a federal project not explicitly related to energy or water conservation or renewable resources. These factors apply only to annual energy usage that is assumed to be the same each year over the service period. The BLCC computer program can compute the present value of energy usage and savings that are not the same in each year.

Examples of How to Use the OMB UPV* Factors:

OMB UPV* (OMB discount rate): To compute the present value over 30 years of electricity costs associated with the occupancy of a federal office building in Ohio (where energy conservation is not a specific consideration in the LCC analysis), go to Table Bb-2, find the OMB UPV* factor for commercial electricity for 30 years (20.32), and multiply this factor by the annual electricity cost in base-date dollars.

Note: Because the discount rate used to calculate the Bb tables (OMB discount rate) is usually different for years 1 to 10 than for years 11 to 30, these factors cannot be used with a planning / design / construction period as shown above for the Ba tables (DOE discount rate). Use the BLCC computer program for this purpose. For further explanation of the use of UPV factors, see NIST Handbook 135.*

2.3. Projected Average Fuel Price Indices and Escalation Rates (Real)

2.3.1. Census Region

Tables Ca-1 through ***Ca-5*** present projected fuel price indices for the four Census regions and for the United States. These indices, when multiplied by annual energy costs computed at base-date prices (i.e., 2024), provide estimates of future-year costs in constant base-date dollars. Constant-dollar cost estimates are needed when discounting is performed with a real discount rate (i.e., a rate that does not include general price inflation). These indices were used in the calculation of the UPV* factors for energy prices in the Ba and Bb tables in this publication.

Example of How to Use the Indices:

To estimate the price of industrial coal in 2025 in Connecticut (in constant 2024 dollars), go to Table Ca-1, find the year 2025 index for industrial coal (1.02), and multiply by the price for industrial coal in Connecticut in 2024.

For further explanation of how to use these tables, see NIST Handbook 135.

Tables Cb-1 through ***Cb-5*** present the projected average fuel price escalation rates (percentage change compounded annually) for selected periods from 2024 to 2054 for the four Census regions and for the overall United States. Note that these are real rates exclusive of general price inflation. Their use results in prices expressed in constant dollars.

The average fuel escalation rates consolidate the information provided by the indices in the Ca tables so that trends in projected price changes can be seen at a glance. They are provided primarily to accommodate computer programs (such as BLCC) which require price escalation rates as inputs.

Unless there is a compelling reason to use escalation rates, it is recommended that you use the indices in the Ca tables when you need estimates of future-year energy prices, since the indices include year-to-year information rather than averages over several years.

Example of How to Use the Escalation Rates:

To estimate the unit price of residential natural gas at the end of 2034 (p_{34}) in Wyoming using the DOE energy price escalation rates, go to Table Cb-4 and find the 2024 to 2029 and the 2029 to 2034 escalation rates for residential natural gas (-6.3 % for 5 years and 0.9 % for 5 years, respectively). Enter these values and the unit price of residential natural gas in Wyoming in 2023 (p_{23}) into the following formula. Then solve for the 2034 energy price (stated in 2024 dollars):

$$p_y = p_{0*} \prod_{i=1}^{N} (1 + e_i)^{k_i}$$

$$\begin{aligned} p_{33} &= p_{23} * (1 + e_1)^{k_1} * (1 + e_2)^{k_2} \\ &= p_{23} * (0.937)^5 * (1.009)^5 \\ &= p_{23} * 0.755 \end{aligned}$$

where *p_y = price at end of year y;*

p_0 = unit price at base date;

e_i = annual compound escalation rate for period i from the Cb tables (in decimal form); and

k_i = number of years over which escalation rate e_i occurs.

Note: The compounded escalation rate factor (0.755) corresponds to the fuel price index in region 4, residential natural gas, for the year 2033 in table Ca-4 (0.76).

The data in the Ca and Cb tables on the following pages are reported for the four Census regions and the U.S. average. Figure B-1 on page 13 presents a map showing the states corresponding to the four Census regions and nine Census divisions. The Census regions do not include American Samoa, Canal Zone, Guam, Puerto Rico, associated states and commonwealths in the Pacific Islands, or the U.S. Virgin Islands. Analysts of federal projects in these areas should use data which are "reasonable under the circumstances," and may refer to the tables with U.S. average data for guidance.

2.3.2. Census Division

Table E and ***Table F*** were introduced in the 2024 release of this document to provide additional variation in the energy price indices and escalation rates, respectively, by using energy price projections at the nine Census divisions instead of the four Census regions. Note that Census division is the most granular level at which the EIA provides long-term projections in the AEO. The data is developed using the same approach as the Census region level data, which is also included in the tables to allow for comparisons across divisions and regions. The format of Table E and Table F is structured to be machine readable to improve useability.

Fig. 2 provides an example for commercial electricity in the West region and its two divisions (Mountain and Pacific) to show how the Division level and Region level data may lead to different energy escalation rates. The US Average is also included for reference. The Pacific and Mountain divisions realize similar general trends, but significantly different magnitudes in changes in electricity. Note that the prices for the West region are largely driven by the Pacific Division because of its higher consumption than that in the Mountain division. Further discussion on the trends in this data will be discussed further in Section 4.

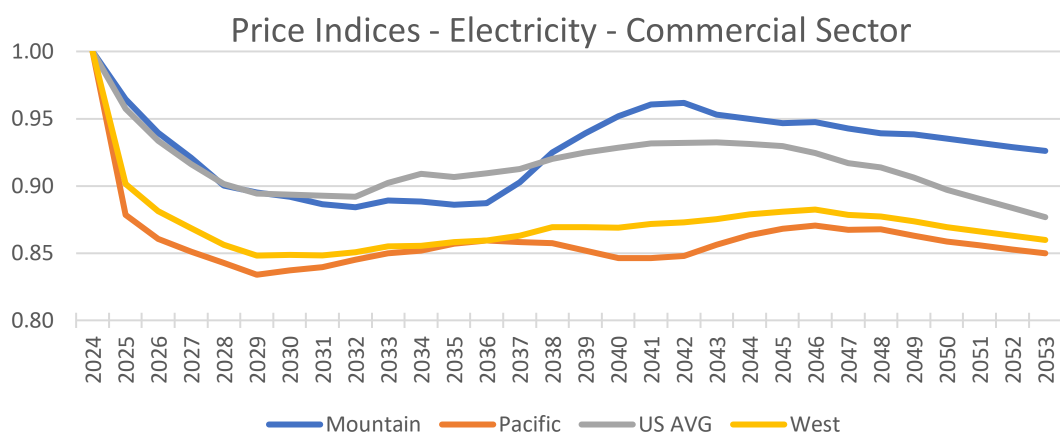

Fig. 2. Electricity price indices for the US, West region, and Mountain and Pacific divisions

2.4. Projected Average Carbon Prices and Emissions Indices

Most financed federal projects, such as Energy Savings Performance Contracts (ESPC), base contract payments on projected annual energy cost savings. When setting up the contract, average rates of energy price escalation over the contract term are a matter of negotiation. One consideration in setting escalation rates is the potential for externality costs being included, either due to legislation leading to price increase expectations or through explicit guidance that requires those externality costs to be included in cost-effectiveness analysis. To assist federal agencies in considering a range of escalation rate scenarios related to proposed legislation in 2010, FEMP introduced to the Annual Supplement a new "D" series of tables projecting potential future carbon prices and electricity-related carbon emissions rates under a range of carbon policy scenarios. To align with executive orders related to climate change in 2021, the methodology used for these projections was modified in 2022 to implement the social cost of greenhouse gas (GHG) emissions estimates as the basis for the cost of carbon and projected emissions rates for electricity from DOE's National Renewable Energy Laboratory (NREL). Average rates of escalation may be calculated for each of these scenarios in the Energy Escalation Rate Calculator (EERC), a BLCC companion program for financed projects. These may be considered by federal agencies for use as energy price escalation rates for contract payments. Please see the most recent FEMP guidance on the use of carbon pricing found here: https://www.energy.gov/femp/articles/guidance-utility-rate-estimations-and-weather-normalization-performance-contracts [6].

Carbon Price Projections. In March 2020, NIST updated the methodology for the carbon price projections. The previous approach was based on the carbon price estimates in the U.S. Environmental Protection Agency (EPA) supplemental analysis of the American Clean Energy and Security Act of 2009 (H.R. 2454) [10]. The analysis was based on multiple peer-reviewed climate economic models, with a particular focus on an economy-wide model known as ADAGE (Applied Dynamic Analysis of Global Economy). Three carbon policy scenarios were created: Medium, Low, and High Pricing Scenarios. Medium Pricing stems from a scenario assuming H.R. 2454 was enacted as is with no changes in the policy design, which does not restrict the type of capacity that electric utilities may install to meet carbon emissions targets. The Medium scenario assumes that all countries, including developing countries, will begin to restrict carbon emissions over the next 40 years. Low Pricing assumes that developing countries do not take any action over the next 40 years to restrict carbon emissions, which decreases the demand for carbon reductions and allows emitters in the United States to purchase carbon offsets from other countries at a lower cost. High Pricing assumes that carbon offsets are not allowed, and nuclear and biomass capacity construction is restricted. Both assumptions limit some of the least expensive options available to decrease carbon emissions, causing carbon prices to increase.

The new approach implemented in 2022 shifts from legislative-based policy projections to the social cost of GHG emissions projections provided in the Interagency Working Group on Social Cost of Greenhouse Gases Interim Estimates under Executive Order 13990 [7] adjusted to 2024 dollars. Like the Pricing Scenarios just described, the new approach also has three scenarios provided for the user to select, which assume different discount rates and projection percentile that provide a range of values that can be used for sensitivity analysis. First, the average social cost of GHG assuming a 3 % discount rate (3 % DR Average) represents the assumptions that best align with the DOE and OMB discount rates. Second, the 95th percentile social cost of GHG assuming a 3 % discount rate (3 % 95th Percentile) represents the highest 5% of projected values. Third, the average social cost of GHG assuming a 5 % discount rate (5 % DR Average).

Table D-1 presents projected U.S. carbon prices per kg/CO_2e under the 3 % DR (Average), 5 % DR (Average), and 3 % DR (95th Percentile).

Carbon Emissions Projections. The initial approach implemented in 2010 to estimate carbon emissions for electricity assumes that electric utilities would adjust to input costs resulting from carbon markets created by legislation by changing their generation mixes to shift from fuels with high carbon content towards cleaner fuel mixes. The new approach implemented in 2022 does not assume any federal legislation and instead assumes that the electricity grid generation mix changes based on projections using current market conditions. NREL's Cambium database [11] (long-run marginal emissions rates) is used for current and projected grid-based electricity emissions factors. EPA's GHG Emission Factors Hub emission factors [12] are used for all other fuel types and assumed to be constant over time. Note that some supply chain-related emissions (typically called Scope 3) are excluded from the emissions factors until further federal guidance is provided. Therefore, the emission factors are primarily Scope 2 for electricity and Scope 1 for on-site consumption of other fuel types. The most recent release of these data sources will be used for this document.

Note: Due to incompatibility of the Cambium data with the required source data needed for the current BLCC version, BLCC uses eGRID 2022 data for electricity [13].

Table D-2 presents U.S. carbon emissions rates by fuel type for 2024. Electricity emissions rates vary by state while on-site consumption of other fuel types is the same regardless of location.

Table D-3 presents U.S. carbon emissions rate projections for electricity by state by year through 2054.

Examples of How to Use the Carbon Prices and Electricity Emissions Indices for Different Fuel Types:

For all fuel types except electricity:

To compute the cost of carbon per GJ in 2040 assuming the average social cost of carbon assuming a 3 % discount rate, go to Table D-1, find the 3 % DR (Average) carbon price (\$0.089/kg CO_2e), and multiply by the kg CO_2e /GJ for the fuel type from Table D-2. This value is the cost of carbon per GJ of energy consumed. For example, the cost of carbon per GJ of natural gas is \$0.089/kg CO_2e * 56.0 kg CO_2e/GJ = \$4.98/GJ (2024 dollars). To obtain the total cost of carbon, multiply this value by the total estimated GJ of energy consumption of the specific fuel type (natural gas) in 2040. Note that the emission rate for non-electricity fuel consumption is assumed constant over time.

If using BLCC there is a simpler approach because BLCC already generates total annual carbon dioxide emissions (in kg). In this case simply multiply the cost of carbon per kg from Table D-1 by the total kg of CO_2 emissions reported in BLCC. Note that this does not account for any other GHG emissions, such as methane in the calculation.

For electricity:

To compute the cost of carbon per GJ in 2040 assuming the average social cost of carbon assuming a 3 % discount rate, go to Table D-1, find the 3 % DR (Average) carbon price (\$0.089/kg), multiply by the kg/GJ in 2024 for electricity for the state (Texas for this example) in which the project is occurring from Table D-2 (96.60 kg CO2e/GJ), and multiply by the projected emissions rate indices for the state for 2040 from Table D-3 (0.364) to calculate the cost of carbon per GJ of electricity consumed in that state in 2040. The cost of carbon per GJ of electricity in 2040 is $0.089/kg CO2e * 96.60 kg CO2e/GJ * 0.364 = $3.13/GJ (2024 dollars). The emissions rate indices adjust the kg/GJ for electricity to account for changes in the fuel mix used in the electric grid, which is projected to, in general, have decreasing emissions rates over time. In this example, emissions rates in Texas are projected to decrease to 36.4% their current emissions rates by 2040.

3. Energy Price Indices for Private Sector LCC Analysis

This section presents tables of projected nominal (i.e., including inflation) fuel price indices for four fuels in the residential sector and five fuels in the commercial sector for each of the years from 2024 through 2054. These price indices are based on the DOE energy price projections, reported in Part I, Section B of this document, used to calculate the FEMP and OMB UPV* factors for energy costs.

As a convenience for the user, the indices include the effect of four alternative, hypothetical rates of general price inflation: 2 %, 3 %, 4 %, and 5 %. Selection of these rates is in no way intended to suggest what actual rates might be. Use of the indices produce price estimates in current dollars, inclusive of general price inflation. Current-dollar prices are needed when discounting is performed with discount rates that include general price inflation (i.e., nominal or market discount rates).

The calculated indices with inflation rates of 2 %, 3 %, 4 %, and 5 % allow the analyst to perform evaluations based on the assumption of a positive rate of general price inflation that changes the purchasing power of the dollar. Performing evaluations in current dollars is sometimes preferred for private investment decisions, primarily because it facilitates the treatment of taxes.

The indices in Tables S-1 through S-5 are derived from the indices reported in Tables Ca-1 through Ca-5 by means of the following equation:

$$I_S = I_C \times (1 + g)^N,$$

where *I_S = index found in Tables S-1 through S-5;*
I_C = index found in Tables Ca-1 through Ca-5;
g = annual rate of general price inflation in decimal form; and
N = number of years, in this case equal to the year of the index minus 2024.

Example of How to Use the Indices:

Suppose you wish to estimate the annual cost of natural gas for a house in Maryland in year 2030, given the annual cost in 2024 prices, and you expect an annual inflation rate of 3% per year. From Table S-3, find the column with residential natural gas indices at an inflation rate of 3%; then locate the index for the year 2030. This index is 1.08. Multiply the annual cost in 2024 prices by the index to find the estimated annual cost in year 2030 prices.

If this annual cost in year-2024 prices is to be discounted to present value, you must use a nominal discount rate that includes the same assumption with regard to general price inflation (3 % in this example). To obtain a present-value cost over the entire study period, the present-value calculation must be repeated for each year that there are natural gas costs, and the results summed. (UPV* factors are not given for private sector use because of the large number of tables required to cover potential discount rates that might be used by the analyst.) The BLCC computer program can perform LCC analyses using any discount rate, in constant or in current (market) dollars. The private sector analyst may use the UPV* factors reported in Part I, provided the analysis is performed in constant dollars and the desired discount rate corresponds to the DOE or OMB discount rates used in Part I.

The data in the S tables are reported for the four Census regions and the U.S. average. **Fig. 1** on page 13 presents a map showing the states corresponding to the four Census regions and nine divisions. The Census regions do not include American Samoa, Canal Zone, Guam, Puerto Rico, associated states and commonwealths in the Pacific Islands, or the U.S. Virgin Islands. Analysts of federal projects in these areas should use data which are "reasonable under the circumstances," and may refer to the tables with U.S. average data for guidance.

4. Trends in Energy Price Projections

This section was added to the 2024 edition of this document because of significant interest in better understanding how the energy price projections have changed over the last couple of years. This new interest was largely driven by the shocks to the energy markets (large increases in prices) from the pandemic and geopolitical turmoil of recent years from which the markets are still developing a new equilibrium. This section will discuss the current EIA energy price projections and why the resulting energy price escalation rates published with in this document may be viewed as lower than expected.

First, it is important to note that the EIA projections are from the 2023 AEO because EIA will not be releasing a 2024 AEO. Per EIA's official press release [14]:

"EIA's National Energy Modeling System (NEMS), which we use to produce our Annual Energy Outlook (AEO), requires substantial updates to better model hydrogen, carbon capture, and other emerging technologies. Our usual AEO publication schedule does not accommodate these necessary model enhancements, which require significant time and resources. As a result, EIA will not publish an AEO in 2024."

Therefore, all projections are based on modeling completed in late 2022 and released in early 2023. These models accounted for the large spikes in the energy prices and projected that the markets would normalize over the following years (typically by 2030). It is possible that more recent projections could provide significantly different escalation rates. This is a limitation driven by the lack of an AEO2024 release. Please see the most recent FEMP guidance on escalation rate selection (found here: https://www.energy.gov/femp/articles/guidance-utility-rate-estimations-and-weather-normalization-performance-contracts [6]), particularly in cases where documented short-term escalation rates from the utility deviate from the projections in this document.

Second, these projections are provided in real terms, which excludes general inflation. Therefore, nominal prices (i.e., the prices consumers see and pay) may increase 10 %, but if general inflation increases at the same rate of 10 % then the real escalation rate is zero. To take this a step further, if nominal energy prices decrease (i.e., revert to previous long-term trends) while general inflation remains positive (i.e., Federal Reserve target of 2.0 %), it can lead to even larger negative real escalation rates.

Third, there may be a recency bias in which consumers expect the most recent short-term trend to continue. In this case, consumers have been seeing higher prices both for general price inflation as well as increases for energy specifically over the last few years. Therefore, they are expecting prices to continue to increase year-over-year. However, both the projections as well as recently available data imply prices have begun to decrease. The remainder of this section will discuss the long-term projections and recent data to provide a better context to what is driving the escalation rate estimates.

Fig. 3 shows the US average real (2023 dollars) price projections from AEO2023 for electricity and natural gas for commercial customers. Electricity is expected to initially decrease in price (negative escalation rates) until 2030, increase from 2030 to the early-2040s, and then trend down again through 2054. Note that the current prices are expected to be much higher than any prices throughout the entire projection. Natural gas is also expected to initially decrease in price (negative escalation rates) until 2028 and then steadily increase until the mid-2040s, although the projection never returns to current price levels. These trends can explain the negative escalation rate estimates from both the 2023 and 2024 releases of this document and associated data in EERC (average real annual escalation rate) and BLCC (non-constant annual real escalation rates), particularly for shorter study periods. Although, please note that these are U.S. average projections and regional and local price changes could vary significantly.

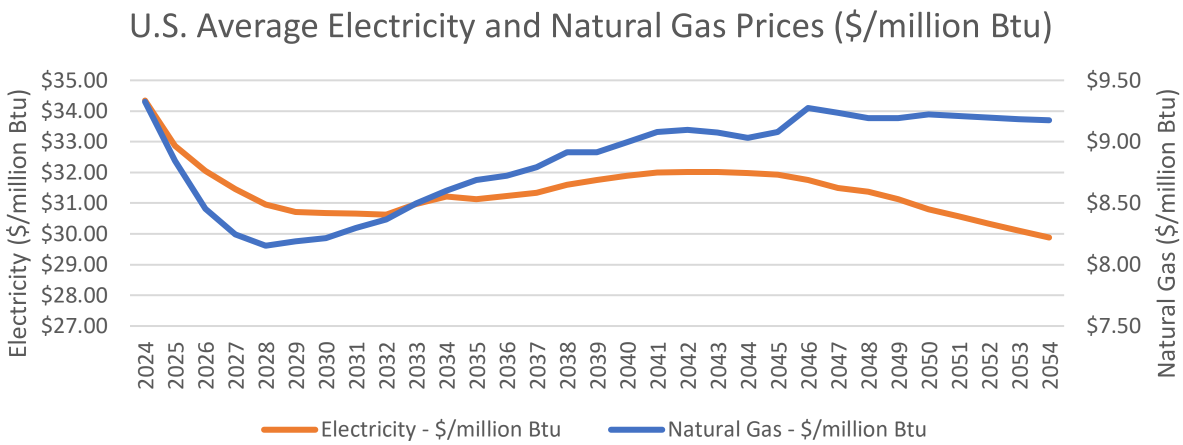

Fig. 3. Energy Prices by Fuel Type (US Average)

The EIA also provides monthly historical data as well as short-term forecasts in their Short-Term Energy Outlook, which both align with the initial trends from AEO2023. Monthly wholesale (i.e., Henry Hub) natural gas prices saw an abrupt drop between August 2022 and February 2023 with prices remaining near those low prices throughout 2023 as shown in **Fig. 4**. **Fig. 5** shows that the EIA projects whole natural gas prices to remain in that range in 2024 and 2025. The commercial sector prices and projections (**Fig. 5**) tend to lag the wholesale prices by approximately a year, implying further annual reductions through 2025.

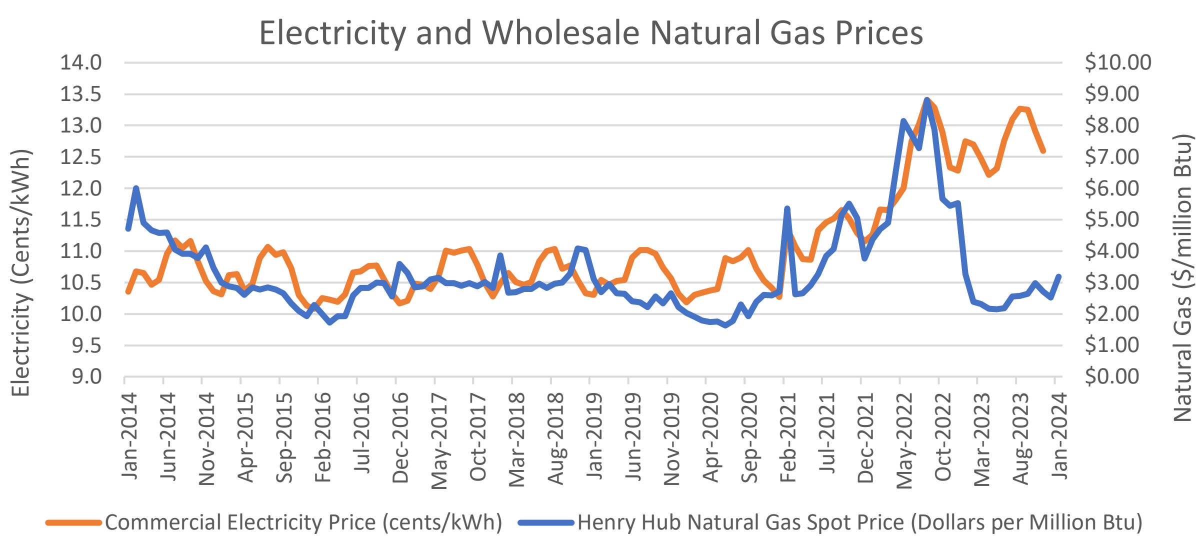

Fig. 4. Natural Gas and Electricity Energy Prices [15, 16]

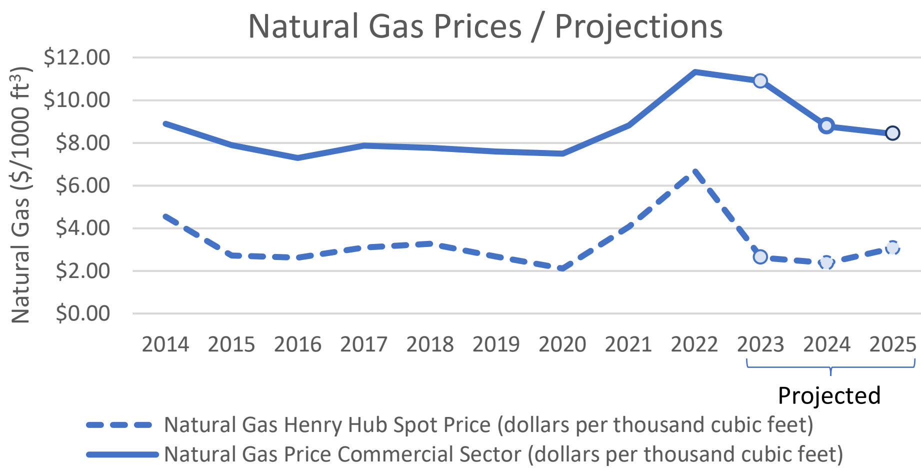

Fig. 5. Natural Gas Prices and Projections (US Average – Commercial and Henry Hub) [17, 18]

Fig. 4 also provides a comparison of wholesale natural gas and electricity prices. Natural gas prices have become increasing important in the electricity market because natural gas has been replacing coal-fired generating units over the last decade (rising from under 25% in 2014 to over 40% in 2023 as shown in **Fig. 6**).

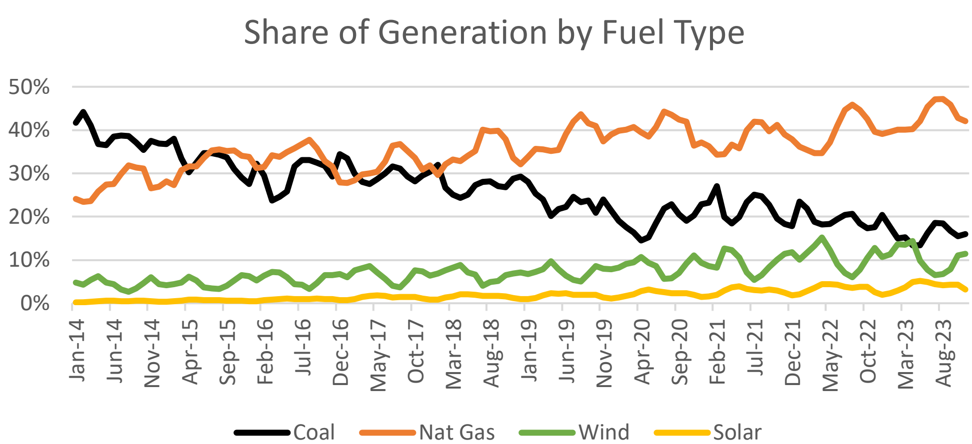

Fig. 6. Share of Generation by Fuel Type (US Average) [19]

As natural gas prices spiked in 2021 and 2022, there is an associated increase in electricity prices (**Fig. 4**). Electricity prices appear to have stopped increasing but have not yet followed natural gas prices down in 2023. As with commercial natural gas prices, there is likely a lag for pricing in lower wholesale natural gas prices into electricity markets, which implies price decreases over the next several years, on average.

The pace of these price changes may vary from utility to utility depending on how utilities contract for their input fuel and get approval for price increases to consumers. **Fig. 7** shows that wholesale electricity price change projections vary across the U.S., with large decreases expected in the Northwest, ERCOT, Southwest, and California, large increases in the Northeast (ISO-NE and NYISO), and minimal change for other regional markets. These results show the importance of providing data at the Census division level instead of the Census region level. These short-term projections generally support the projections from AEO2023, although it is important to consider utility specific variation over the next year or two when considering appropriate escalation rate assumptions. Please see the most recent FEMP guidance on escalation rate selection (found here: https://www.energy.gov/femp/articles/guidance-utility-rate-estimations-and-weather-normalization-performance-contracts [6]), particularly in cases where documented short-term escalation rates from the utility deviate from the projections in this document.

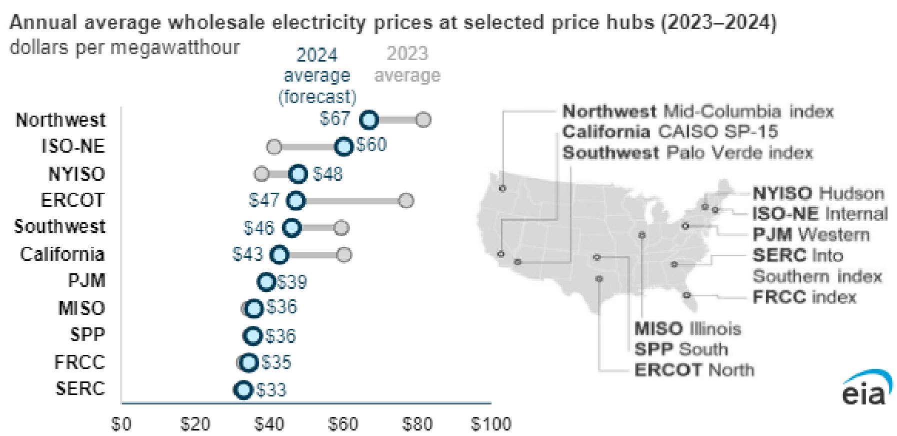

Fig. 7. Wholesale Electricity Prices by ISO for 2023 (actual) and 2024 (projected) [20]

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Supplemental Data

Versions of this document prior to 2022 included data tables that have been moved to an associated spreadsheet for a given release year (NISTIR85-3273-XX.xlsx). The data table nomenclature has been updated as of the 2023 release to align with the new NIST Technical Publication formatting. The data tables are in the following spreadsheet tabs:

- ENCOST File - Raw energy price data in the original format received from EIA
- Discount Rate Memo - Discount rate and inflation data used for calculations
- Table A - SPV, UPV, and UPV* values for non-energy costs
- Table B - UPV* values for energy costs (Census region)
- Table C - Projected real fuel price indices (Census region)
- Table D - Carbon dioxide equivalent emissions rates and costs
- Table E - Projected real fuel price indices (Census region and division) - NEW
- Table F - Projected real fuel annual escalation rates (Census region and division) - NEW
- Table S - Projected nominal fuel price indices

The spreadsheet is packaged in the supplement ZIP file from FEMP's BLCC main page (https://www.energy.gov/femp/building-life-cycle-cost-programs) or available from NIST at the following DOI: https://doi.org/10.18434/mds2-3194.

Appendix A. Abbreviations

Abbreviations

A	-	Annual amount
A_0	-	Annual amount at base-date prices
ADAGE	-	Applied Dynamic Analysis of Global Economy
AEO2023	-	Annual Energy Outlook 2023 (DOE-EIA publication)
BLCC	-	NIST Building Life Cycle Cost computer program
CO2	-	Carbon Dioxide
COAL	-	Coal
d	-	discount rate
DIST	-	Distillate Oil
DOE	-	U.S. Department of Energy
e	-	price escalation rate (annual rate of price change)
EIA	-	Energy Information Administration (DOE)
ELEC	-	Electricity
EPA	-	U.S. Environmental Protection Agency
ESPC	-	Energy Savings Performance Contract
FEMP	-	Federal Energy Management Program
FY	-	Fiscal Year
GASLN	-	Gasoline
GHG	-	greenhouse gas
kg	-	kilogram
LCC	-	Life-Cycle Cost
LPG	-	Liquefied petroleum gas
N	-	Number of discount periods (in years)
NEMS	-	National Energy Modeling System
NIST	-	National Institute of Standards and Technology
NREL	-	National Renewable Energy Laboratory
NTGAS	-	Natural Gas
OMB	-	Office of Management and Budget
RESID	-	Residual Oil
SPV	-	Single Present Value (factor)
SSC	-	Social Cost of Carbon
UESC	-	Utility Energy Services Contract
UPV	-	Uniform Present Value (factor)
UPV*	-	Modified Uniform Present Value (factor)