2024 IECC Residential Cost Effectiveness Analysis Proposal

This proposal is similar to the 2015 DOE cost analysis methodology for evaluating cost-effectiveness of residential energy code changes[1], but it uses updated sources for some parameters and is simplified to ease the burden for proponents to analyze their proposed amendments. The methodology and input parameters described here have been integrated into an accompanying calculator tool that produces the results.

The proposed methodology uses a lifecycle cost (LCC) approach, where the cashflows over an analysis period for cash outflows (expenses, negative values) and inflows (savings, positive values) are used to calculate a net present value based on the time value of money. A positive LCC value indicates that the savings of a measure exceed its costs over the analysis period, while a negative value indicates the opposite.

For costs, the proposed methodology assumes that any up-front incremental costs are financed through the mortgage on the home. Most proposed code amendments will predominantly impact new construction, and most new homes are financed through a 30-year mortgage. The mortgage terms from the DOE National Cost Effectiveness of the Residential Provisions of the 2021 IECC[2] were used.

In the calculator, the LCC is calculated with, and results are provided for, three different discount rates. A February 15, 2022 memo[3] from the ICC directed the code development committees to use the 3% and 7% real discount rates from 2003 U.S. Office of Management and Budget circular A-4[4] in cost-effectiveness calculations. The ICC memo also stated that "these rates are currently used to support the statutory review DOE conducts upon release of a new edition of the IECC." The DOE methodology for evaluating cost-effectiveness of residential energy code changes does not use the OMB discount rates, but rather considers the 30-year mortgage rate as the appropriate discount rate for evaluating IECC residential measures[5]:

> Because DOE's economic perspective is that of a homeowner, that time value is determined primarily by the owner's best alternative investment at similar risk to the energy features being considered—in this case a typical homeowner who holds a home throughout a 30-year mortgage term. DOE sets the discount rate equal to the mortgage

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[1] Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes, Pacific Northwest National Laboratory, 2015, https://www.energycodes.gov/sites/default/files/2021-07/residential_methodology_2015.pdf
[2] Salcedo et al, National Cost Effectiveness of the Residential Provisions of the 2021 IECC https://www.energycodes.gov/sites/default/files/2021-07/2021IECC_CostEffectiveness_Final_Residential.pdf
[3] https://cdn-www-v2.iccsafe.org/wp-content/uploads/IECC-Discount-Rates-and-Code-Content-Memorandum_02_15.22.pdf
[4] https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/circulars/A4/a-4.pdf
[5] Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes, Pacific Northwest National Laboratory, 2015, https://www.energycodes.gov/sites/default/files/2021-07/residential_methodology_2015.pdf

interest rate in nominal terms. Because mortgage prepayment is an investment available to consumers who purchase homes using financing, the mortgage interest rate is a reasonable estimate of a consumer's alternative investment rate.

The calculator tool therefore provides results at the 3% and 7% real OMB discount rates, as well as the 3% nominal discount rate used in the National Cost Effectiveness of the Residential Provisions of the 2021 IECC[6], which is based on the 2015 DOE cost analysis methodology.

Given the high standard deductible for federal income taxes ($25,900 for joint filers), it is assumed that the increase in mortgage payments does not result in a change in income taxes. It is also assumed that proposed measures have a minimal impact on property assessments for local taxes, so changes in property taxes are assumed to be zero. Property tax assessments tend to be based on high-level data points, such as floor area, general condition, location, number of bedrooms and bathrooms, presence of air conditioning, and types of wall and floor finishes. It is not clear that the cost of efficiency-related features will result in an identical increase in property-tax valuation, and the DOE methodology document provides no supporting evidence for the assumption that it will.

Estimates of measure costs should be clearly documented and adhere to accepted practices. Potential sources include recent published studies, surveys of retailer prices, RS Means residential cost data, and expert judgement. Cost estimates should be regionalized when appropriate. For measures that have an expected life of less than the 30-year analysis period, a cost for replacement should be assigned to the expected year this will occur.

For savings, the reduced or increased energy consumption produced by building energy modeling or other calculations are used to calculate annual changes in energy costs based on forecasted energy prices. Energy consumption calculations should be documented and reflect standard accepted practices. Change in energy consumption should be calculated for each climate zone unless it can be demonstrated that climate does not substantially impact savings. Cost-effectiveness can then be calculated for each climate zone. If needed, an overall cost effectiveness can then be calculated by weighting the results appropriately for each climate zone. The social cost of avoided carbon emissions can be included in the savings. It is calculated using EIA emissions factors and the cost data from the Interagency Working Group on Social Cost of Greenhouse Gases.

Electricity and natural gas, and optionally propane, should be represented proportionately to their expected use as a heating fuel in the area under study. For measures that have an expected life of less than the 30-year analysis period, the residual value of the replacement measure is assigned as a positive cashflow in year 30 based on a straight-line depreciation. Changes in non-energy operating costs, such as increased or decreased maintenance associated with a measure are not included unless they are deemed significant for a particular measure.

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[6] Salcedo et al, National Cost Effectiveness of the Residential Provisions of the 2021 IECC https://www.energycodes.gov/sites/default/files/2021-07/2021IECC_CostEffectiveness_Final_Residential.pdf

Energy prices used to calculate savings are based on national averages of projected prices. The use of regional prices was investigated, but overlaying EIA regional prices onto IECC climate zones, which have substantially different borders, adds a significant increase in difficulty.

The following table summarizes the parameters needed for the LCC modeling and their sources:

Parameter	Value	Source
Mortgage Interest Rate	3.0% nominal	DOE 2021 Cost Effectiveness Analysis[7]
Loan Term	30 years	DOE 2021 Cost Effectiveness Analysis
Down Payment Rate	12%	DOE 2021 Cost Effectiveness Analysis
Points and Loan Fees	1%	DOE 2021 Cost Effectiveness Analysis
Discount Rate	3.0% nominal	DOE 2021 Cost Effectiveness Analysis
Period of Analysis	30 years	
Property Tax Rate	Not used	
Income Tax Rate	Not used	
Home Price Escalation Rate	Not used	
Inflation Rate	2.3%	EIA AEO 2021[8]
Residual value	0 for measures with life >= 30 years, straight line depreciation for measures replaced within 30 years	
Initial fuel prices	Elec: 0.1372 $/kWh Gas: 1.1803 $/therm Propane: 2.48 $/gal	Electricity: 2021 US residential price from EIA electric power monthly[9] Natural gas: 2021 US residential price from EIA natural gas annual[10] Propane: Average 2021 EIA monthly residential heating season price.[11]
Fuel price escalators	Elec: -0.1% Gas: 0.5% Propane: 1.4%	EIA AEO 2021 reference case, residential by fuel, national[12]

[7] Salcedo et al, National Cost Effectiveness of the Residential Provisions of the 2021 IECC https://www.energycodes.gov/sites/default/files/2021-07/2021IECC_CostEffectiveness_Final_Residential.pdf
[8] https://www.eia.gov/outlooks/aeo/excel/aeotab_20.xlsx
[9] https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=table_5_03
[10] https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_a.htm, https://www.eia.gov/totalenergy/data/monthly/pdf/sec12_5.pdf
[11] https://www.eia.gov/dnav/pet/pet_pri_wfr_dcus_nus_m.htm
[12] https://www.eia.gov/outlooks/aeo/excel/aeotab_3.xlsx

First cost for measures		Sources must be documented. (Potential sources include recent published studies, surveys of retailer prices, RS Means residential cost data, expert judgement.)
Change in energy consumption as compared to baseline		Sources must be documented. Building energy modeling or other calculations that use standard accepted practices. Calculated for each climate zone unless it does not substantially impact savings.
Changes in non-energy operating expenses	Assumed to be zero unless warranted for a specific measure	
Social cost of carbon	$51 per metric ton in 2020 (@3% real discount rate)	Interagency Working Group on Social Cost of Greenhouse Gases[13]

[13] https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf