# Impacts of the E-QUIP Tax Proposal

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## Key Takeaways

We estimate the following cumulative impacts from the E-QUIP tax proposal if enacted (main scenario):

- 130,000 net additional job-years (total years of employment)
- $15 billion energy-bill savings (present value)
- $11 billion added business and federal investment
- 100 million tons of $CO_2$ emissions avoided (equivalent to the emissions of 22 million cars and light trucks in a year)

## Introduction

The 2017 Tax Cut and Jobs Act sought to spur jobs and economic growth by encouraging business investment, including allowing immediate expensing (bonus depreciation) for most business investments through 2022 (phasing out through 2027). However, investments with a depreciation recovery period of more than 20 years are not eligible for expensing. Furthermore, the law created the "163(j)" election, under which many commercial real estate businesses must use the longer Alternative Depreciation System (ADS) and forfeit their eligibility for bonus depreciation (so they can deduct business interest instead). The taxable income of Real Estate Investment Trust (REIT) shareholders is also generally calculated under the ADS. The 2017 law also created a new depreciable asset class for improvements to commercial buildings called Qualified Improvement Property (QIP), but QIP does not include residential, structural, or exterior improvements.

The result is that investments in existing commercial and multifamily buildings are still subject to a range of depreciation periods depending on the kind of building, whether the product is interior or exterior, and the tax status of the owner, as shown in table 1. Note that this patchwork of depreciation periods is unrelated to the actual useful lives of the products, with the product's depreciation period often longer than its lifetime. This creates a disincentive to invest in new equipment and building upgrades, which generally save energy and reduce greenhouse gas (GHG) emissions.[1]

Table 1. Depreciation period for commercial and multifamily building investments in years

| | Residential | Commercial interior (QIP) | Commercial structural + exterior |
|---|---|---|---|
| General depreciation system (GDS) | 27.5 | 15 or 1 | 39 |
| Alternative depreciation system (ADS) | 30 | 20 | 40 |

Reflects a recent technical fix to the tax code for QIP enacted in Public Law 116-136. QIP that is under the GDS may be eligible for bonus (first year) depreciation.

The Energy Efficient Qualified Improvement Property (E-QUIP) proposal would give building energy investments accelerated and uniform 10-year depreciation if they meet strict energy efficiency criteria. This depreciation would apply to heating and cooling equipment, lighting, controls for equipment and lighting, and building shell components (such as windows and insulation) installed from 2020 to 2025. The full list of products and criteria and the efficiency levels we assumed is presented in Appendix A.

This issue brief estimates the energy, environmental, financial, and economic impacts of the E-QUIP proposal.

## Methodology

We modeled the impacts of the incentive on the basis of data on the specific eligible products and two approaches to estimating its market impacts for each product. Except for controls, we assumed that the accelerated depreciation would primarily impact owners who were already planning to purchase new products by influencing their choice of a standard or an efficient product. Thus, we collected information on the energy use, cost (including installation), sales, and lifetimes of new covered equipment and building components with typical efficiency levels and of similar products that meet the criteria of the draft bill. These data came from a variety of sources, including technical support documents for Department of Energy (DOE) rulemakings, the Energy Information Administration's (EIA) *Commercial Buildings Energy Consumption Survey* (*CBECS*), RSMeans, market surveys, and expert judgment. These assumptions are detailed in Appendix B.

We used EIA's *Annual Energy Outlook* for projected energy costs and average carbon intensities. We assumed a small increase in use of the products due to energy cost savings (rebound). For financial assumptions, we consulted with The Real Estate Roundtable and the National Association of Real Estate Investment Trusts (Nareit®) on the ownership of commercial and multifamily buildings and the applicable marginal tax rates and depreciation schedules. We analyzed commercial and multifamily buildings separately (and QIP separately from other commercial investments, but then combined the results). A portion of the investments were financed with loans.

We took a rough blended average of tax rates and depreciation systems. We assumed that approximately a quarter of commercial and multifamily buildings are owned by governments and nonprofit organizations and thus are ineligible for depreciation and that two-thirds of the rest are owned by individuals or by entities taxed at the investor level (e.g., partnerships, REITs, S corporations) and thus are effectively taxed at individual rates. We also assumed most buildings are subject to the ADS recovery periods. For estimating market impacts of the incentive, we assumed owners discount interest and tax payments at the financing interest rate but that they discount energy savings more heavily. When presenting financial results, we discount all savings and spending at a 5% real rate. Detailed financial assumptions are also presented in Appendix B.

Note that the data predate, and the analysis does not attempt to account for, the current dramatic reduction in commercial building occupancy—and corresponding increase in daytime multifamily unit usage—due to the COVID-19 pandemic. The long-term impacts are not yet clear.

Although most of the efficient products appear to be cost effective without any incentive, current market adoption is mostly very low for a variety of reasons (see text below table B3). Consequently, we cannot use a simple investment analysis to project the market effects of accelerated depreciation. After considering several ways of estimating the impacts, we report two here. The main scenario is based on assuming a wide range of implicit discount rates for the energy savings, leading to a normal distribution of the price at which building owners will buy the efficient products and an S-curve (cumulative normal distribution) of market share of the efficient product. The present value of the tax incentive then shifts the price and pushes the market share from the current value up along the S-curve (see figure 1 for an illustration).

The alternative scenario uses a demand elasticity for the cost of capital, an approach used to estimate the impact of tax policy on investments.[2] Analogous to a price–demand elasticity, the increase in demand of the efficient product is proportional to the decrease in the cost of capital due to the incentive. The cost of capital is the before-tax return from energy savings needed to yield a specified after-tax rate of return; the incentive means less energy savings are needed to yield the same after-tax return (for this calculation, we use monthly savings as the return rather than a percentage rate of return). Note that this estimate is not based on actual energy savings but on the marginal return that should make the investment worthwhile. We use a relatively high elasticity, –1, for the direct product substitution considered here.

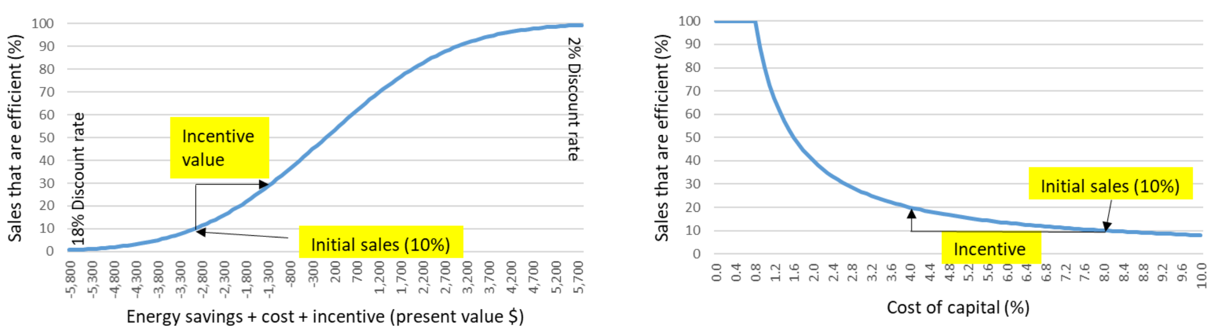


Figure 1. Illustrations of the market impact of the incentive in two scenarios: the range of implicit discount rates and the cost of capital elasticity

The jobs analysis used a version of our Dynamic Energy Efficiency Policy Evaluation Routine (DEEPER) input–output model, which is based on IMPLAN data. We estimated how many jobs would be created and lost due to the added investment in efficiency measures, the net reduced tax payments, and the consequent reduction in payments from consumers to utilities (including effects from the loss of other uses of those funds). We included direct, indirect and induced job impacts resulting from those shifts in funds in construction, manufacturing, the energy sector, and throughout the economy. The economic analysis methodology is more fully described in previous work.[3]

## Analysis of Impacts

The American Council for an Energy-Efficient Economy (ACEEE) analyzed the economic and environmental impacts the E-QUIP proposal would have if enacted. Here we discuss the market impacts, financial and environmental impacts, and jobs impacts for the two scenarios described above.

## Incentive Values and Market Impacts

The incentive is the difference between the baseline depreciation and the accelerated 10-year depreciation under E-QUIP. The implicit incentive value for each product is shown in Appendix C. Because the incentive is based on the total installed cost of the qualifying product and the product's lifetime, and not on the added cost or on the energy savings compared with the standard product, the relative value of the incentive is different for each product. It ranges from 3% to more than 150% of the added cost of the efficient product and from 2% to more than 600% of the present value of the energy savings. The residential and QIP incentives are somewhat lower than the other commercial incentives, as the baseline depreciation periods are shorter.

Because both the value of the incentive and the current market share vary widely by product and by scenario, the market effects also vary widely (shown in Appendix C). The percentage of the market reached by the incentive (inefficient products installed in the base case) ranges from 0% to 100%. The impact is larger when the efficient product starts with a significant market share and when the incentive value is large compared with the energy savings (in the main scenario) or the added cost (in the alternative scenario).

## Energy, Environmental, and Financial Impacts

The resulting energy, carbon, and bill savings are significant. Figure 2 and table 2 show results by product category; Appendix C includes more-detailed results. In the main scenario, we estimate that over their lifetimes, the measures spurred by this incentive would save $15 billion in energy bills (present value) and eliminate carbon dioxide emissions equivalent to the tailpipe emissions of 22 million cars and light trucks in a year or more than 560,000 rail cars full of coal. The cost in this scenario is $5 billion in lost tax revenue and another $5 billion in spending by building owners (both present value). The lost tax revenue includes the increase in depreciation for the efficient product under E-QUIP, the reduced tax write-off for energy costs due to the energy savings, and the write-off for interest paid on financing (all assumed to be at the same tax rates).[i] In the alternative scenario, the impacts are somewhat smaller.

About nine-tenths of the impacts are in commercial buildings because that sector is much larger than the multifamily sector. The savings vary significantly by sector and product, and the associated breakdowns vary significantly by scenario. In the main scenario, the impact is greatest from heating, ventilation, and air-conditioning (HVAC) controls, lighting controls, and roof insulation. However, the cost for some building shell improvements (roof insulation and windows) is relatively high, so with our assumptions, the total costs (present value of business and federal investment) are higher than the energy savings. The savings from other measures more than offset these net costs. In the alternative scenario, most of the savings are from HVAC controls and lighting.

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[i] Note this is not the same as the legislative tax "score" from the Joint Committee on Taxation, which does not consider effects on energy use or other such economic impacts (and will make its own projection of usage).

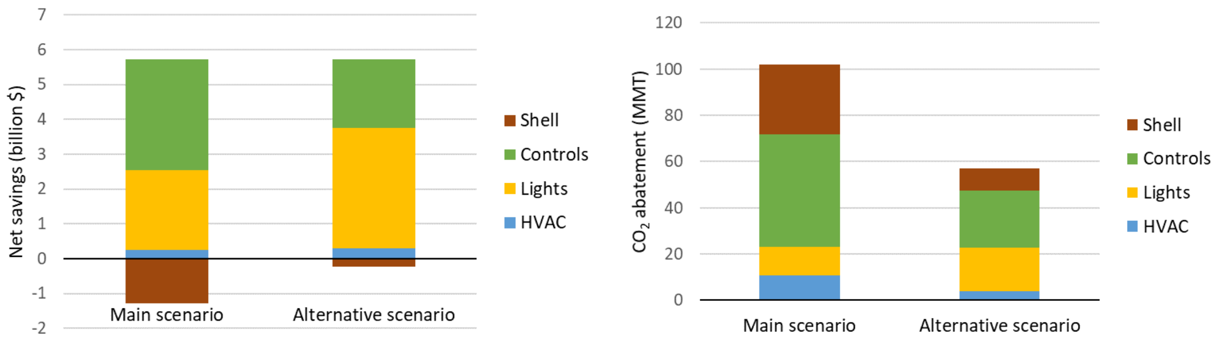


Figure 2. Net energy-bill savings after added investment (net present value for the lifetime of measures implemented 2020–2025) and reduction in $CO_2$ emissions (cumulative million metric tons (MMT) for the lifetime of measures) under two impact scenarios

Table 2. Cumulative energy and carbon savings and present value of financial savings and spending in two impact scenarios

| | Cumulative savings | | Investment and savings present value (million $) | | | |
|---|---|---|---|---|---|---|
| | Energy (TBtu) | Carbon dioxide (MMT) | Net savings | Energy-bill savings | Building-owner investment | Reduced federal taxes |
| **Main scenario** | | | | | | |
| HVAC | 253 | 11 | 243 | 1,537 | 1,225 | 69 |
| Lighting | 335 | 12 | 2,303 | 2,499 | 258 | –62 |
| Controls | 1,232 | 49 | 3,178 | 7,781 | 3,496 | 1,107 |
| Building shell | 691 | 30 | –1,294 | 3,148 | 209 | 4,234 |
| **Total** | **2,510** | **102** | **4,430** | **14,966** | **5,188** | **5,348** |
| **Alternative scenario** | | | | | | |
| HVAC | 89 | 4 | 297 | 445 | 71 | 77 |
| Lighting | 505 | 19 | 3,461 | 3,758 | 634 | –337 |
| Controls | 613 | 25 | 1,974 | 3,890 | 319 | 1,597 |
| Building shell | 201 | 10 | –227 | 797 | –2,608 | 3,631 |
| **Total** | **1,407** | **57** | **5,506** | **8,889** | **–1,584** | **4,968** |

## Jobs Impacts

The accelerated depreciation would also boost the economy, as illustrated by the net creation of jobs. The investment in improved efficiency creates jobs in construction and manufacturing. The energy savings result in job creation throughout the economy as owners or tenants spend the energy savings. As investment is drawn from other areas and as spending declines in the energy sector, some job losses will also occur, but those will be smaller than the gains. Figure 3 shows the net number of jobs added due to the incentives each year in the main scenario. We estimate that added jobs will increase to more than 9,000 in 2025, then slowly decrease until the energy savings run out. The total net job creation due to the incentives is almost 130,000 job-years (sum of the net number of jobs added for each year). In the alternative scenario, the total net job creation is almost 80,000 job-years. Our analysis assumes the provision is in place only through 2025; if it is extended, then the job and other benefits would increase relative to the values we show here.

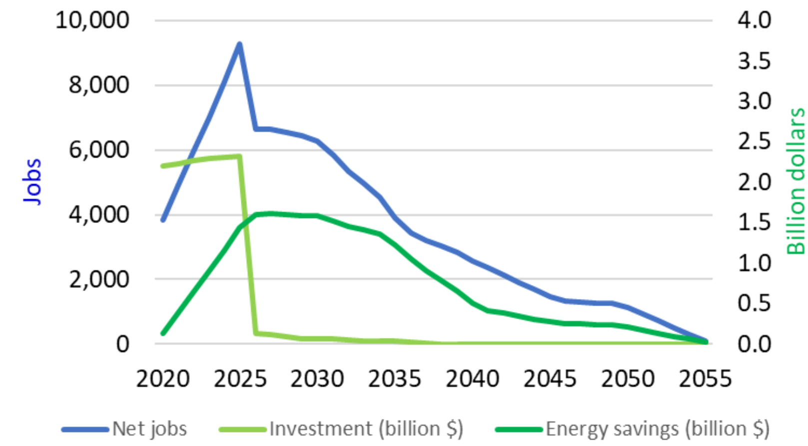


Figure 3. Net increase in jobs, total investment, and energy-bill savings by year

## Conclusion

The current depreciation schedules for most commercial and multifamily building equipment and components require recovery periods that generally exceed their economic lifetimes, and the schedules discourage investment that would help meet our energy and environmental goals. The E-QUIP proposal would consistently apply accelerated depreciation for products that meet strict energy efficiency criteria and would provide a significant incentive to invest in energy-saving equipment. Although a consistent incentive based on total purchase price and product lifetime cannot be calibrated to the added cost and commercialization stage of each product (as utility rebates could be), and it is difficult to forecast the exact impact for each product, this incentive would clearly spur a significant increase in building investments as well as significant energy savings and reductions in carbon emissions.

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## Appendix A. E-QUIP Criteria and Product Efficiencies

Table A1. E-QUIP tax-incentive criteria and analysis product efficiency assumptions

| E-QUIP criteria | | Analysis efficiency assumptions | |
|---|---|---|---|
| Products | Criteria | Base product | Efficient product |
| **HVAC + hot water** | | | |
| Unitary air conditioner (AC, small) | CEE Tier 2 (2019) | 12.9 IEER | 14.8 IEER |
| Unitary AC (large) | CEE Tier 2 (2019) | 11.6 IEER | 14.2 IEER |
| Unitary heat pump (HP, small) | CEE Tier 2 (2019) | 12.2 IEER | 13.6 IEER |
| Unitary HP (large) | CEE Tier 1 (2019) | 11.6 IEER | 12.8 IEER |
| Boiler (gas) | CEE Tier 1 (2015) | 80% Et | 93% Et |
| Water heater (gas) | CEE Tier 1 (2012) | 80% Et | 93% Et |
| Water heater (electric) | COP $\geq$ 3 | 100-gal tank 0.8 COP | 100-gal tank 4.2 COP |
| Variable speed drive (pump) | | 5-hp pump motor | Add VSD |
| Variable speed drive (fan) | | 5-hp fan motor | Add VSD |
| **Lighting** | | | |
| Interior lights | IGCC 2018 | 32-W T8 lamp | 18-W LED T8 |
| Exterior lights | IGCC 2018 | 175-W metal halide | 46-W LED |
| **Controls** | | | |
| Smart building controls | | HVAC system | Add smart controls |
| Smart lighting controls | | Lighting system | Add smart controls |
| **Building shell** | | | |
| Roof insulation | IGCC 2018 | R-12-30 | R-30-35 |
| Wall insulation | IGCC 2018 | R-11.4 | R-13.3 |
| Windows + skylights | IGCC 2018 | 0.36 U \| 0.38 SHGC | 0.29 U \| 0.36 SHGC |

CEE is the Consortium for Energy Efficiency, IEER is the integrated energy efficiency ratio, Et is the thermal efficiency, COP is the coefficient of performance, VSD is a variable speed drive, IGCC is the International Green Construction Code, R is the R-value (thermal resistance), U is the U-value (heat transfer coefficient), and SHGC is the solar heat gain coefficient.

For electric water heaters, we looked at efficiencies of current products.

For lighting, we assumed replacement with LED lights (based on an earlier version of the proposal).

For roof insulation, we used for the base product a blended average of 25% R-12.4, 25% R-20, and 50% R-25.4 (South) or 30.5 (North), and for the efficient product R-30.5 (South) or R-35 (North). We assumed criteria in the South raised to R-30 because the IGCC is the same as in the 90.1-2016 model code.

We did not include variable refrigerant flow multisplit AC+HP in the analysis because there is no good current metric or way to determine savings. Water-cooled and evaporatively cooled unitary AC and chillers are also not included in the analysis because of their small market share and limited data.

## Appendix B: Analysis Assumptions

### Detailed Product Assumptions

Table B1. Analysis assumptions on product lifetimes, costs, and energy savings

| Products | Lifetime of efficient product (years) | Lifetime of base product (years) | Cost of efficient product ($) | Cost difference from base unit ($) | Annual electric savings (kWh) | Annual gas savings (MMBtu) |
|---|---|---|---|---|---|---|
| **HVAC + hot water** (units) | | | | | | |
| Unitary AC (small) | 21.0 | | 11,584 | 1,547 | 5,914 | – |
| Unitary AC (large) | 22.6 | | 19,424 | 2,967 | 11,476 | – |
| Unitary HP (small) | 21.1 | | 11,333 | 1,077 | 4,082 | – |
| Unitary HP (large) | 22.6 | | 19,473 | 1,306 | 4,557 | – |
| Boiler (gas) | 24.8 | | 43,000 | 4,500 | −254 | 107 |
| Water heater (gas) | 11.0 | | 5,537 | 1,221 | −92 | 17 |
| Water heater (electric) | 10.0 | 13.0 | 35,925 | 20,695 | 13,445 | – |
| VSD (pump) | 15.0 | | 4,274 | 4,274 | 9,909 | – |
| VSD (fan) | 15.0 | | 3,670 | 3,670 | 3,789 | – |
| **Lighting** (thousands) | | | | | | |
| Interior lights | 14.4 | 9.6 | 21,450 | 7,870 | 43,680 | – |
| Exterior lights | 10.3 | 3.9 | 404,763 | 40,755 | 287,304 | – |
| **Controls** (thousand sq. feet) | | | | | | |
| Smart building controls | 15.0 | | 2,500 | 2,500 | 4,335 | 11 |
| Smart lighting controls | 20.0 | | 1,500 | 1,500 | 1,156 | – |
| **Building shell** (average buildings) | | | | | | |
| Roof insulation | 30.0 | | 21,825 | 10,332 | 3,200 | 14 |
| Wall insulation | 30.0 | | 3,730 | 196 | 125 | 5 |
| Windows + skylights | 30.0 | | 67,543 | 3,305 | 314 | 12 |

kWh is kilowatt-hour and MMBtu is million British thermal units. *Sources:* HVAC: DOE Technical Support Documents for standards rulemakings;[4] VSD costs and savings derived from 2015 DOE analysis.[5] Lighting: costs derived from RSMeans data (initial exterior cost is for wall pack), savings from wattage and typical usage. Controls: savings from 29% of average whole-building energy use and 45% of average lighting energy use.[6] Building energy use (including by end-use) from *CBECS*.[7] Building shell: costs derived from RSMeans data and residential window data from a Pacific Northwest National Laboratory (PNNL) study,[8] roof savings derived from a Bayer study,[9] and wall and windows savings from calculators.[10]

Table B2. Analysis assumptions on initial (baseline) product sales

| Products | Total sales (or potential sales) | Total sales of efficient product | Sales in existing buildings (%) | Comm. exterior sales (%) | QIP sales (%) | Multifamily sales (%) |
|---|---|---|---|---|---|---|
| **HVAC + hot water** (units) | | | | | | |
| Unitary AC (small) | 121,000 | 2,904 | 80 | 43 | 43 | 13 |
| Unitary AC (large) | 42,000 | 2,394 | 80 | 47 | 47 | 6 |
| Unitary HP (small) | 19,000 | 1,045 | 80 | 43 | 43 | 13 |
| Unitary HP (large) | 1,000 | 34 | 80 | 47 | 47 | 6 |
| Boiler (gas) | 17,076 | 6,932 | 78 | 0 | 96 | 4 |

| Products | Total sales (or potential sales) | Total sales of efficient product | Sales in existing buildings (%) | Comm. exterior sales (%) | QIP sales (%) | Multifamily sales (%) |
|---|---|---|---|---|---|---|
| Water heater (gas) | 96,687 | 22,971 | 65 | | 87 | 13 |
| Water heater (electric) | 89,390 | 894 | 57 | | 87 | 13 |
| VSD (pump) | 484,000 | 45,306 | 80 | | 94 | 6 |
| VSD (fan) | 484,000 | 45,306 | 80 | | 94 | 6 |
| **Lighting** (thousands) | | | | | | |
| Interior lights | 123,712 | 81,200 | 89 | | 92 | 8 |
| Exterior lights | 9,558 | 6,200 | 87 | 92 | | 8 |
| **Controls** (thousand sq. feet) | | | | | | |
| Smart building controls | 8,910,343 | 5,758,363 | 80 | | 94 | 6 |
| Smart lighting controls | 6,682,757 | 1,958,881 | 80 | | 98 | 2 |
| **Building shell** (average buildings) | | | | | | |
| Roof insulation | 302,340 | 30,234 | 75 | 87 | | 13 |
| Wall insulation | 56,000 | 5,600 | 100 | 87 | | 13 |
| Windows + skylights | 267,127 | 133,563 | 50 | 87 | | 13 |

*Sources:* Total and efficient sales: HVAC: same as table B1. Lighting: derived from a DOE study.[11] Controls: derived from *CBECS* market penetration. Building shell: roof: same as table B1; wall: assume 1% of buildings each year; windows: total from DOE 2009 data[12], assume efficient portion 50%. Portion of sales in existing, commercial, and multifamily buildings: ACEEE estimates and relative HVAC and lighting energy use.

Table B3. Baseline product cost and sales comparisons

| | Product cost | | Sales |
|---|---|---|---|
| Products | Simple payback | Added cost as % of base cost | Sales that are efficient (%) |
| **HVAC + hot water** | | | |
| Unitary AC (small) | 2.4 | 15 | 2 |
| Unitary AC (large) | 2.4 | 18 | 6 |
| Unitary HP (small) | 2.5 | 11 | 6 |
| Unitary HP (large) | 2.7 | 7 | 3 |
| Boiler (gas) | 5.7 | 12 | 41 |
| Water heater (gas) | 10.0 | 28 | 24 |
| Water heater (electric) | 14.3 | 136 | 1 |
| VSD (pump) | 4.0 | | 9 |
| VSD (fan) | 9.0 | | 9 |
| **Lighting** | | | |
| Interior lights | 1.7 | 58 | 66 |
| Exterior lights | 1.3 | 11 | 65 |
| **Controls** | | | |
| Smart building controls | 4.5 | | 65 |
| Smart lighting controls | 12.1 | | 29 |
| **Building shell** | | | |

| | Product cost | | Sales |
|---|---|---|---|
| Products | Simple payback | Added cost as % of base cost | Sales that are efficient (%) |
| Roof insulation | 22.9 | 90 | 10 |
| Wall insulation | 4.0 | 6 | 10 |
| Windows + skylights | 26.8 | 5 | 50 |

Simple payback is the added cost of the efficient product divided by the annual energy-bill savings.

The simple payback numbers for many of these products suggest that building owners should already be choosing the efficient products, but the sales numbers indicate that they are not. A large literature on the "energy efficiency gap" finds that an array of market barriers, such as lack of information, split incentives, and externalities, prevent individuals and companies from making investments in energy efficiency that would seem highly cost effective.[13] Utility energy efficiency programs and efficiency tax incentives such as this one (as well as efficiency standards and energy codes) are largely designed to overcome those barriers and help individuals and companies cost effectively reduce their energy use.

## Tax and Financial Assumptions

### *Tax Assumptions*

Owner receives deduction for total cost of eligible product, including installation, with straight-line depreciation. The tax reduction is the deduction amount times the marginal tax rate.

- Baseline depreciation: Commercial structural + exterior (Com): 40 years; commercial interior (QIP): 20 years; multifamily (MF): 30 years

  *The Real Estate Roundtable collected information suggesting that a large majority of the private real estate market took the "163(j)" election. According to Nareit, public REITs own 20% of investment-grade, commercial real estate; they distribute at least 90% of their taxable income to shareholders as dividends; to the extent of the REIT's "earnings and profits," the dividends also use the ADS schedule.*

- E-QUIP depreciation: 10 years
- E-QUIP effective dates: 2020–2025
- % of markets that are taxable: Com, QIP, MF: 75%

  *Excludes buildings owned by governments or nonprofits based on limited data.*

- % of taxable owners that have tax liability and depreciation: Com, MF: 100%; QIP: 90%

  *Exclude 10% of QIP as eligible for bonus depreciation.*

- % of covered market that actually takes the credit: 100%
- Marginal tax rate: 27%

  *This is a blended rate. Most commercial real estate is owned by individuals or by partnerships, S corporations, or REITs, the income of which is mostly taxed when it reaches the shareholders at individual rates. The highest income individual marginal rate is 37%, but many of these* *taxpayers can now take the Section 199A 20% deduction on business income, so the effective rate is 30%. Other buildings are subject to the lower corporate tax rate (21%) or a lower individual rate. A few states also apply the accelerated depreciation to state taxes.*

- Secondary effects: Include energy-use expensing and increased loan-interest expensing at same rate. Do not account for change in taxes for utilities, manufacturers, and so on.

### *Market and Financing Assumptions*

- % of investment that is financed: 15% of equipment, 50% of building shell components

  *Rough estimate from RER.*

- Loan terms: 15 years at 2% above the 10-year Treasury rate (which is 4.9–5.3% nominal in 2020–2025 based on an inflation rate of 2.3–2.5%)

  *As commercial loans often are refinanced after several years, this attempts to represent overall financing. Treasury rate from* Annual Energy Outlook 2020.[14]

### *Impact Assumptions*

Main scenario (normal distribution calculation based on a range of implicit discount rates)

- Implicit discount rate for valuing loan payments and taxes: 1.4% real (or 3.8% nominal)

  *Same as current loan interest rate after taxes.*

- Range of implicit energy discount rates: 1.4% to 18.6% (average 10%). Range of present values of the energy savings is matched to 2.5 standard deviations of the normal distribution (range from 0.6% market share for efficient products to 99.4%).[ii]

Alternative scenario (elasticity calculation based on cost of capital)

- Elasticity: –1

  *Elasticity of investment with cost of capital tends to be –0.5* to *–1.*[2]

- Implicit discount rate for valuing loan payments and taxes: 1.4% real as in the main scenario

Rebound

- % increase in use (and hence energy use) of more-efficient products: 5%

  *Typical rebound for commercial buildings.*[15]

Discount rates

- Discount rate for financial impacts—savings, depreciation, and loan payments (real): 5%

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[ii] Note the most relevant experience with the scale of impacts of which we are aware is utility incentive programs. MassSave utility programs estimate "net-to-gross ratios" (percentage of the incentive that goes to measures taken because of the incentive) for commercial equipment from 30% to 95%; this fraction may be lower for a commercial tax incentive because owners who would have bought the efficient unit anyway are more likely to know about the incentive.

Energy, costs, and emissions

- Projected electricity and natural gas prices (residential for multifamily buildings) and average carbon emissions intensities: from *Annual Energy Outlook 2020*.[14]

### Tax incentive value

Table B4. Present value of the E-QUIP accelerated depreciation

| Products | Commercial | QIP | Multifamily | Com/QIP incentive % of cost difference | Com/QIP incentive % of PV energy savings |
|---|---|---|---|---|---|
| **HVAC + hot water** (per unit) | | | | | |
| Unitary AC (small) | 765 | 398 | 642 | 38 | 15 |
| Unitary AC (large) | 1,347 | 667 | 1,117 | 34 | 13 |
| Unitary HP (small) | 751 | 389 | 630 | 53 | 21 |
| Unitary HP (large) | 1,350 | 669 | 1,120 | 77 | 33 |
| Boiler (gas) | | 1,477 | 2,563 | 33 | 29 |
| Water heater (gas) | | 116 | 155 | 10 | 20 |
| Water heater (electric) | | 632 | 842 | 3 | 10 |
| VSD (pump) | | 130 | 181 | 3 | 2 |
| VSD (fan) | | 111 | 156 | 3 | 5 |
| **Lighting** (per thousand) | | | | | |
| Interior lights | | 630 | 873 | 8 | 3 |
| Exterior lights | 11,253 | | 10,005 | 28 | 8 |
| **Controls** (per thousand sq. feet) | | | | | |
| Smart building controls | | 76 | 106 | 3 | 3 |
| Smart lighting controls | | 52 | 81 | 3 | 7 |
| **Building shell** (per average building) | | | | | |
| Roof insulation | 1,733 | | 1,345 | 17 | 57 |
| Wall insulation | 296 | | 230 | 151 | 90 |
| Windows + skylights | 5,363 | | 4,161 | 162 | 644 |

## Appendix C. Detailed Results of Analysis

### Sales Impacts

Table C1. Impact of E-QUIP incentive on product sales

| | Main scenario | | | Alternative scenario | | |
|---|---|---|---|---|---|---|
| Products | Number of added efficient units | Base units affected (%) | Efficient units that are due to incentive (%) | Number of added efficient units | Base units affected (%) | Efficient units that are due to incentive (%) |
| **HVAC + hot water** (units) | | | | | | |
| Unitary AC (small) | 3,402 | 5 | 67 | 1,609 | 2 | 49 |
| Unitary AC (large) | 1,531 | 7 | 53 | 1,081 | 5 | 44 |
| Unitary HP (small) | 1,515 | 15 | 72 | 1,670 | 16 | 74 |
| Unitary HP (large) | 106 | 19 | 84 | 322 | 58 | 94 |
| Boiler (gas) | 2,916 | 54 | 44 | 2,598 | 48 | 41 |
| Water heater (gas) | 28,563 | 87 | 74 | 1,454 | 4 | 12 |
| Water heater (electric) | 5,511 | 16 | 94 | 15 | 0 | 4 |
| VSD (pump) | 5,595 | 2 | 19 | 985 | 0 | 4 |
| VSD (fan) | 13,780 | 6 | 36 | 985 | 0 | 4 |
| **Lighting** (thousands) | | | | | | |
| Interior lights | 3,203 | 12 | 6 | 5,594 | 22 | 10 |
| Exterior lights | 1,484 | 68 | 27 | 2,080 | 95 | 34 |
| **Controls** (thousand sq. feet) | | | | | | |
| Smart building controls | 202,977 | 12 | 6 | 125,209 | 7 | 4 |
| Smart lighting controls | 277,203 | 11 | 21 | 47,453 | 2 | 4 |
| **Building shell** (average buildings) | | | | | | |
| Roof insulation | 73,450 | 48 | 81 | 3,999 | 3 | 19 |
| Wall insulation | 29,604 | 78 | 88 | 37,800 | 100 | 90 |
| Windows + skylights | 50,086 | 100 | 50 | 50,086 | 100 | 50 |

### Energy, Environmental, and Financial Impacts

Table C2. Cumulative energy and carbon savings for commercial and multifamily buildings

| | Electricity (TWh) | | Natural gas (TBtu) | | Carbon dioxide (MMT) | |
|---|---|---|---|---|---|---|
| | Commercial | Multifamily | Commercial | Multifamily | Commercial | Multifamily |
| **Main scenario** | | | | | | |
| HVAC | 15.7 | 3.0 | 68 | 8 | 9 | 1 |
| Lighting | 33.1 | 3.3 | – | – | 11 | 1 |
| Controls | 103.6 | 8.1 | 178 | 18 | 45 | 4 |
| Building shell | 39.1 | 4.4 | 265 | 33 | 27 | 3 |
| **Total** | **191.6** | **18.8** | **511** | **58** | **93** | **10** |
| **Alternative scenario** | | | | | | |
| HVAC | 4.3 | 0.5 | 37 | 4 | 4 | 0 |

| | Electricity (TWh) | | Natural gas (TBtu) | | Carbon dioxide (MMT) | |
|---|---|---|---|---|---|---|
| | Commercial | Multifamily | Commercial | Multifamily | Commercial | Multifamily |
| Lighting | 50.0 | 5.1 | – | – | 17 | 2 |
| Controls | 48.2 | 4.5 | 110 | 11 | 23 | 2 |
| Building shell | 5.0 | 0.7 | 121 | 18 | 9 | 1 |
| **Total** | **107.5** | **10.7** | **269** | **33** | **52** | **5** |

Table C3. Present value of financial savings and spending for commercial and multifamily buildings

| | Net savings | | Energy -bill savings | | Building -owner investment | | Reduced federal taxes | |
|---|---|---|---|---|---|---|---|---|
| | Commer- cial | Multi- family | Commer- cial | Multi- family | Commer- cial | Multi- family | Commer- cial | Multi- family |
| **Main scenario** | | | | | | | | |
| HVAC | 234 | 9 | 1,252 | 284 | 925 | 300 | 94 | –25 |
| Lighting | 2,044 | 259 | 2,222 | 277 | 221 | 38 | –42 | –20 |
| Controls | 2,747 | 431 | 7,048 | 733 | 3,206 | 290 | 1,095 | 13 |
| Shell | –1,242 | –53 | 2,738 | 411 | 206 | 3 | 3,773 | 460 |
| **Total** | **3,783** | **647** | **13,260** | **1,706** | **4,558** | **630** | **4,919** | **428** |
| **Alternative scenario** | | | | | | | | |
| HVAC | 259 | 39 | 391 | 53 | 58 | 12 | 75 | 2 |
| Lighting | 3,071 | 390 | 3,341 | 417 | 555 | 79 | –285 | –52 |
| Controls | 1,713 | 261 | 3,472 | 418 | 239 | 80 | 1,520 | 77 |
| Shell | –225 | –1 | 669 | 127 | –2,348 | –260 | 3,243 | 388 |
| **Total** | **4,817** | **688** | **7,874** | **1,015** | **–1,496** | **–88** | **4,553** | **415** |

Table C4. Cumulative energy and carbon savings for commercial and multifamily buildings

| | Electricity (TWh) | | Natural gas (TBtu) | | Carbon dioxide (MMT) | |
|---|---|---|---|---|---|---|
| | Commercial | Multifamily | Commercial | Multifamily | Commercial | Multifamily |
| **Main scenario** | | | | | | |
| HVAC | 15.7 | 3.0 | 68 | 8 | 9 | 1 |
| Lighting | 33.1 | 3.3 | – | – | 11 | 1 |
| Controls | 103.6 | 8.1 | 178 | 18 | 45 | 4 |
| Building shell | 39.1 | 4.4 | 265 | 33 | 27 | 3 |
| **Total** | **191.6** | **18.8** | **511** | **58** | **93** | **10** |
| **Alternative scenario** | | | | | | |
| HVAC | 4.3 | 0.5 | 37 | 4 | 4 | 0 |
| Lighting | 50.0 | 5.1 | – | – | 17 | 2 |
| Controls | 48.2 | 4.5 | 110 | 11 | 23 | 2 |
| Building shell | 5.0 | 0.7 | 121 | 18 | 9 | 1 |
| **Total** | **107.5** | **10.7** | **269** | **33** | **52** | **5** |

Table C5. Annual energy and carbon savings in 2025 (for all measures taken 2020-2025)

| | Electricity (TWh) | Natural gas (TBtu) | Total energy (TBtu) | $CO_2$ emissions (MMT) | Energy bill (billion $) |
|---|---|---|---|---|---|
| **Main scenario** | | | | | |
| HVAC | 1.2 | 4 | 15 | 0.6 | 0.16 |
| Lighting | 3.0 | – | 27 | 1.0 | 0.31 |
| Controls | 6.3 | 12 | 71 | 2.8 | 0.76 |
| Building shell | 1.3 | 9 | 22 | 1.0 | 0.21 |
| **Total** | **11.7** | **25** | **137** | **5.4** | **1.45** |
| **Alternative scenario** | | | | | |
| HVAC | 0.2 | 2 | 4 | 0.2 | 0.04 |
| Lighting | 4.4 | – | 41 | 1.5 | 0.47 |
| Controls | 3.1 | 7 | 37 | 1.5 | 0.39 |
| Building shell | 0.2 | 4 | 6 | 0.3 | 0.05 |
| **Total** | **7.9** | **13** | **88** | **3.4** | **0.95** |

## Jobs Impacts

Table C6. Investment, energy-bill savings, and jobs impacts for selected years in the main scenario

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|
| Investment (billion $) | 2.20 | 2.23 | 2.26 | 2.29 | 2.31 | 2.32 |
| Energy savings (billion $) | 0.13 | 0.39 | 0.64 | 0.90 | 1.16 | 1.45 |
| Construction jobs | 5,180 | 5,196 | 5,213 | 5,228 | 5,230 | 5,235 |
| Manufacturing jobs | 4,127 | 4,144 | 4,161 | 4,177 | 4,188 | 4,200 |
| Energy industry jobs | –14 | –447 | –879 | –1,314 | –1,762 | –2,239 |
| Other jobs | –7,370 | –6,124 | –4,881 | –3,632 | –2,309 | –894 |
| **Net added jobs** | **3,834** | **4,892** | **5,945** | **6,997** | **8,099** | **9,284** |
| | **2030** | **2035** | **2040** | **2045** | **2050** | **2055** |
| Investment (billion $) | 0.06 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| Energy savings (billion $) | 1.58 | 1.22 | 0.50 | 0.27 | 0.22 | 0.02 |
| Construction jobs | 29 | 67 | 53 | 27 | 21 | 2 |
| Manufacturing jobs | 72 | 82 | 50 | 27 | 21 | 2 |
| Energy industry jobs | -2,683 | -2,104 | -880 | -517 | -413 | -37 |
| Other jobs | 7,715 | 5,311 | 2,801 | 1,584 | 1,245 | 112 |
| **Net added jobs** | **6,284** | **3,913** | **2,578** | **1,454** | **1,133** | **102** |

The sectoral jobs numbers include only direct and indirect jobs.

## Endnotes

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