Lifting the Cap: Estimating the Economic Impacts of Energy Efficiency Investments in Pennsylvania

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Abstract

This paper analyzes the job-creation impacts of increased energy efficiency investments from electric distribution utilities in the Commonwealth of Pennsylvania. Under current Pennsylvania law, efficiency investments are artificially capped, limiting energy savings and associated economic benefits. Using input–output modeling, we evaluate the economic impacts of a scenario unconstrained by an investment cap, where electricity savings rise to 1.2% over the period 2021–2025. We find that unconstrained investments could create more than 30,000 jobs, a 50% increase compared to a scenario where a cap constrains them.

Background

In 2008, the Pennsylvania legislature passed Act 129, establishing the framework for the Commonwealth's electric savings targets. The act called on the Public Utility Commission (PUC) to establish an energy efficiency and conservation (EE&C) program beginning in 2009. This program requires each electric distribution company (EDC) with at least 100,000 customers to adopt a plan to reduce energy consumption within its service territory. These EDCs include Duquesne Light Co., Metropolitan Edison Co. (Met-Ed), Pennsylvania Electric Co. (Penelec), Pennsylvania Power Co. (Penn Power), West Penn Power Co., PECO Energy Co., and PPL Electric Utilities. Together, they serve more than 5.5 million customers across Pennsylvania (EIA 2018).

Act 129 included specific minimum consumption reductions for Phase I, requiring each EDC to achieve energy savings of at least 1% by May 31, 2011, and 3% by May 31, 2013. The legislation included several other important components, including instructions for reporting, penalties for failure to meet energy savings targets, and a requirement that EE&C plans not exceed 2% of EDC total 2006 revenue (Pennsylvania General Assembly 2008).

Energy savings targets for Phase II were set by the Pennsylvania PUC. The targets covered the three-year period from June 2013 to May 2016, with compliance assessed at the end of the phase. Targets were utility-specific and ranged from 1.6% savings over three years for West Penn Power to 2.9% for PECO. The average annualized target across all seven obligated EDCs was about 0.72% (Pennsylvania PUC 2017). Phase III targets were also set by the PUC and covered a longer period (June 2016–May 2021). These ranged from 2.6% over five years for West Penn Power to 5% for PECO, equivalent to about 0.5% to 1% annualized electricity savings (Pennsylvania PUC 2015b).[1] Averaged statewide, these targets are equivalent to about 0.8% of sales (ACEEE 2017).

For Phases II and III, the PUC set targets based largely on the results of potential studies conducted by the Statewide Evaluator (SWE).[2] These studies include three estimates of potential: maximum achievable potential, with incentives equivalent to 100% of measure costs and accordingly higher participation rates; base achievable potential, with incentives based on historic levels; and program potential, which constrains EE&C program rollout to levels lower than base achievable due to the cost cap. As the PUC noted in its Final Implementation Order for Phase III, "Without a budget cap, incremental annual savings could achieve roughly 1.2% to 2.0% of 2010 load in the base achievable and maximum achievable scenarios, respectively" (Pennsylvania PUC 2015b). Table 1 shows cumulative results of the SWE potential study for Phase III as well as the final targets adopted by the PUC.

[1] EDCs are not required to achieve savings evenly over each year of the phase. However the Phase III Implementation Order does ask EDCs to achieve at least 15% of the required electricity savings in each year of the phase.

[2] Final targets deviated somewhat from the results of the SWE studies based on stakeholder input as part of Docket Nos. M-2012-2289411 and M-2008-2069887.

Table 1. Sum of incremental statewide efficiency potential for Phase III EE&C programs

	Maximum achievable potential	Base achievable potential	Program potential	Implemented target
Statewide average	9.8%	6%	4.5%	3.5%

Savings represent the sum of incremental savings to be achieved over the five-year phase. Note that the implemented target is slightly below the calculated program potential to accommodate greater spending on low-income programs. *Source:* Pennsylvania PUC 2015b.

Over the first seven years of program implementation, EDCs have delivered significant energy savings to residents and businesses across Pennsylvania, consistently meeting goals (Pennsylvania PUC 2017). Act 129 delivered $6.4 billion in benefits to customers by the end of Phase II (KEEA 2018), and benefits will continue to accrue throughout Phase III. However electricity savings remain below the base achievable potential in the state and below savings achieved in neighboring states such as Maryland, New York, and Ohio, which are driven by stronger goals (Berg et al. 2018). Table 2 shows electricity savings goals for neighboring mid-Atlantic states.

Table 2. Electricity savings goals for neighboring states

State	Average annual savings target
Maryland	2.0%
New York	2.0%
New Jersey*	1.5%
Ohio	1.0%
Pennsylvania	0.80%

* New Jersey achieved savings equivalent to Pennsylvania in 2017 but set stronger targets in 2018.

The next phase of Act 129 will begin in 2021. In this paper, we estimate the economic impacts of a ramp-up to 1.2% incremental electricity savings over five years. We analyze 1.2% because it is an achievable level of energy savings, about equivalent to the base achievable scenario identified by the SWE's Phase III potential study.[3] It is also consistent with the increase in energy savings evaluated in a 2018 study of economic impacts by Takahashi, Malone, and Hall of Synapse Energy Economics, Inc.

Results

If energy savings rise gradually to 1.2% over Phase IV due to its programs and targets, we estimate that energy efficiency measures installed between 2021 and 2025 would create enough economic activity (during installation and over the life of the measures) to support

[3] Statewide base achievable incremental savings as calculated by the SWE ranged from 1.1% to 1.3% over the period 2016–2020.

more than 30,000 jobs in Pennsylvania.[4] This increase in employment would be driven by a combination of the efficiency investments and the customer bill savings they generate. Pennsylvania families and businesses would save over 90,000 GWh and about $6.4 billion net over the life of the installed measures.

In the scenario analyzed in this paper, energy savings increase by about 50% over current cost-constrained levels. If EDCs continue to implement programs at constrained base-case levels, we would still expect to see jobs created across Pennsylvania. However the impacts would be smaller, about 20,000 jobs and $4.3 billion in net savings for energy consumers across the state. Figure 1 shows job impacts by year for both the base (cost-constrained) and the alternate (unconstrained) cases.

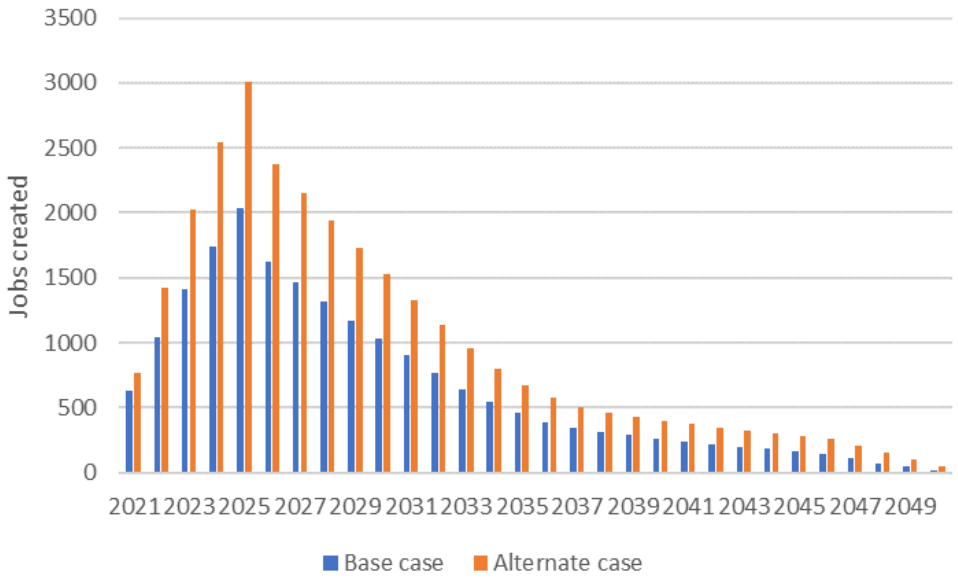

Figure 1. Jobs created by year for a five-year implementation phase beginning in 2021. Although the efficiency programs examined in this analysis run only through 2025, job impacts linger, with new jobs being created through 2050. If efficiency programs continue to be implemented past 2025, jobs numbers would continue to grow.

The largest share of the job creation impacts stem from two separate influences. The first is the growth in demand for industries that implement energy efficiency measures. These include various construction and related industries as well as their supply chains. With an investment of over $2.5 billion over a five-year period, employment in these industries will increase by about 20,000 jobs. However these jobs tend to be relatively short-lived, lasting only as long as they are required to implement the programs.

The second would occur in the service sector, including retail industries. Consumers and businesses spend a significant share of their disposable income on services of various types.

[4] The term *job* in this context means one year of full-time-equivalent employment. Our analysis presents results in terms of net jobs, accounting for both job creation and job loss in different sectors of the economy.

These services would see a large increase in demand and job creation. These jobs will be longer term, as consumers spend their energy bill savings year after year, but may be harder to identify as they will be spread over a larger portion of the economy and a longer period.

Methodology

In this paper, a *job* is defined as one year of full-time-equivalent employment. One job could be one person employed full time for one year, or two people employed half time for a year, or one person employed half time for two years, and so on.

We report results in terms of jobs created. A created job can be either a new job generated or a job not lost. The dynamic energy efficiency policy evaluation routine (DEEPER) model (described in Appendix A), like most similar models, calculates the number of full-time-job equivalents that would be supported by the activities under consideration, but it cannot tell whether these are newly created jobs or ones that would otherwise disappear.

We report our employment results in terms of net jobs created. This accounts for both jobs created or saved and jobs that might be lost due to changes in spending patterns resulting from the policy in question. In particular, we account for any jobs lost in electricity generation and related sectors.

We used our DEEPER modeling framework to estimate the economic impacts of lifting the cost cap to remove artificial spending constraints on the implementation of Phase IV of Act 129. We based our estimates of cost-effective savings on a scenario in which targets are not constrained by an arbitrary cost cap. We include in our analysis the full investments EDCs would need to undertake to achieve these savings along with any changes in revenue resulting from implementation of EE&C programs.

SAVINGS

We base potential Phase IV savings on a 2018 study by Takahashi, Malone, and Hall of Synapse Energy Economics, Inc. assessing the impacts of expanding EE&C programs beyond the current budget caps. Synapse estimated that savings would increase by 0.2% of sales per year throughout Phase IV, with EDCs reaching 1.2% savings on average by 2025. The study found that removing cost caps and allowing for a gradual program ramp-up would result in 50% more investment in energy efficiency and provide 50% more savings and net benefits. Figure 2 illustrates the difference in savings.

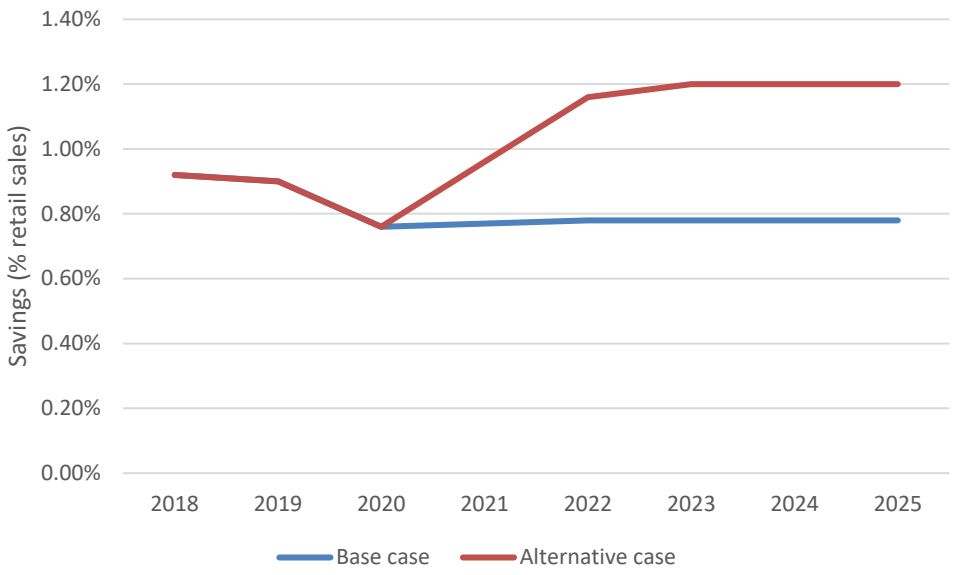

Figure 2. Estimated energy savings for base case (with cost cap constraint) versus alternative case.
Source: **Takahashi, Malone, and Hall 2018.**

Consistent with the Synapse study, the savings estimates we present are relatively conservative. In the most recent statewide potential study, the SWE found base achievable incremental savings to be 1.2% in 2025. This represents savings based on historical incentive levels and adoption rates and does not account for improvements in program design or higher levels of incentives. Maximum achievable savings were 50% higher: 1.8% (Pennsylvania PUC 2015).

We also assume that Phase IV of Act 129 implementation occurs over a five-year period, from 2021 to 2025. This is consistent with the length of Phase III implementation. In its Phase III Implementation Order, the commission noted that the five-year phase would "aid in the implementation of more comprehensive programs" and that a "five year program provides additional benefits, such as savings in costs, time and resources related to litigating and administering the EE&C plans" (Pennsylvania PUC 2015b, 14). The commission cited additional benefits of the five-year phase, including "more consistency and continuity, further enhancing the customer experience and increasing the potential for customer engagement in the program" (Pennsylvania PUC 2015b, 14–15). While Act 129 is likely to continue through future phases, we limit our analysis to the likely length of Phase IV. If savings targets continue into the future, or energy savings rise to levels higher than those included in our analysis, the EE&C programs would likely deliver additional net jobs to the Commonwealth.

Figure 3 shows total annual savings from 2021–2025 measures.

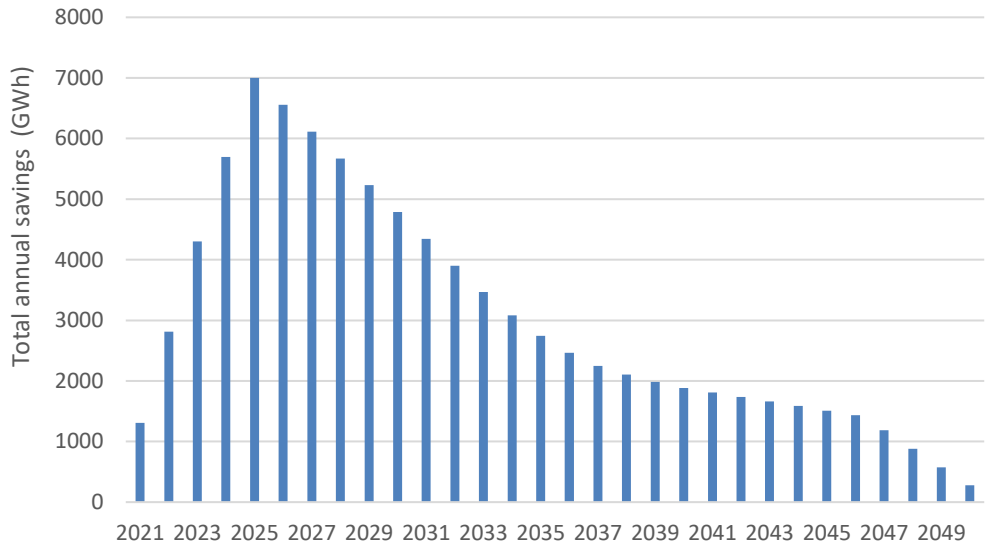

Figure 3. Total annual savings from measures installed 2021–2025. Savings persist long after the program phase examined in this report. If program implementation were to continue past 2025, savings would continue to grow.

Figure 3 shows the savings from Phase IV programs last well beyond 2025. Efficiency measures typically continue to save energy after they are put in place, and those installed during Phase IV continue returning some savings through 2050. Figure 3 shows savings beginning to decline in 2026, reflecting our assumption that savings from efficiency measures decrease over time.[5] We model this decline as a straight-line reduction in performance beginning in the year after the measures are put in place and continuing until they reach their maximum expected life. We expect the average useful life of residential efficiency measures to be just over 6 years and that of commercial and industrial (C&I) measures to be about 13 years.[6] That means that while half of the commercial measures may need to be replaced in 13 years, we anticipate that half will last longer than that, with a small share of them functioning for 26 years.

COSTS

We modeled investments required to ramp up to 1.2% electricity savings using budgets laid out by Takahashi, Malone, and Hall (2018). In that study, program costs of saved energy were based on EDC reported costs for 2016 and Phase III projected costs for 2017–2020. The study used a statewide average cost of saved energy and adjusted projected costs by comparing planned versus actual costs in 2016. As in Takahashi, Malone, and Hall (2018), we used EDC's Phase III filings to split program costs and savings between residential and C&I sectors.

[5] Our analysis is limited to a five-year period. If EE&C programs are approved past 2025, total annual savings would likely continue to grow.

[6] These measure lives are consistent with Takahashi, Malone, and Hall (2018) and based on data reported by EDCs for EE&C Program Year 8.

We estimate cost savings by multiplying energy savings by average retail electricity prices in Pennsylvania in 2017, about $0.14 per kWh for residential customers, $0.09 for commercial customers, and $0.067 for industrial customers. We also use electric-sector growth rates from the US Energy Information Administration (EIA), about 0.6% annually for residential and commercial sectors and 1% for the industrial sector (EIA 2019). Pennsylvania EDCs report program savings for C&I customers (separating large and small) without distinguishing between the commercial and industrial sectors. For the purposes of our analysis, we have assumed that efficiency investments across these two categories are split evenly between commercial and industrial customers and have allocated the economic inputs and outputs accordingly.

Finally, because Pennsylvania is a net exporter of electricity, we assume that any reductions in electricity consumption come at the expense of reduced generation in the state as opposed to reductions in electricity imports from other states.

Conclusion

Allowing energy efficiency programs to grow beyond current levels in Pennsylvania could be a major job creator for the Commonwealth. Energy efficiency programs have hyperlocal employment impacts, generating not only demand for contractors and the construction sector, but also more-diffuse job-creation impacts due to the energy savings these programs generate. Unleashing these economic benefits will require ramping up efficiency across Pennsylvania, engaging businesses and residents alike to generate energy savings and create jobs.

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Appendix A. ACEEE's DEEPER Model

We have used ACEEE's DEEPER modeling framework to conduct this assessment. DEEPER employs principles of input–output (I/O) modeling to evaluate the economic impacts of various policy alternatives. Simply put, the model tracks changes in demand for goods and services across the Pennsylvania economy and determines how much output from each economic sector is required to meet that demand. It then asks how much labor is required to produce that output and how much state gross domestic product (GDP) (or value added) is associated with that change in demand.

The core of the DEEPER model is the A matrix, or direct requirements matrix. This relates industries to one another, detailing how much input from one industry is required to make a dollar's worth of output from another industry. Combining this information with a final demand vector, which represents changes in demand for goods and services for final consumption, returns the amount of output required from each industry to support that level of final demand. For any given increase in final demand of goods and services, determining how much additional output each industry would have to create to meet this increase is conceptually straightforward.

A second critical component of DEEPER is a set of multipliers that convert the resulting increases in output into the amount of employment needed to bring about those increases, how much income that would generate for workers, and how much GDP that would create. DEEPER uses data from the IMPLAN Group for its national and state-level A matrices and multipliers.

We calculate changes in final demand using data on expenditures on energy efficiency, the lifetime energy savings they generate, and the associated avoided energy costs as described in the preceding. We consider the cost of the efficiency investments as well as the lost revenues to utilities that result from reduced energy consumption. We also account for interstate and international trade by using regional purchase coefficients that indicate how much of each type of good and service consumed in Pennsylvania is also produced there. The model allocates changes in final demand among in-state and out-of-state producers accordingly, so that only changes in Pennsylvania-based producers contribute to state employment and value added.

We aggregate all of these state-level impacts to calculate the net change in Pennsylvania final demand across 14 economic sectors. The DEEPER model translates these net changes into changes in output and calculates the changes in employment and value added associated with them. The model includes employment and value added associated with the changes in demand, changes in production along the supply chain required to meet that demand, and increased economic activity generated by workers spending their increased income.