Painting the Whole Picture: Understanding the Impacts of Energy Efficiency Using Cost-Effectiveness Testing and Economic Impact Assessments

Zach Ross, Opinion Dynamics, State College, PA
John Tortorella, Opinion Dynamics, Waltham, MA
Jake Millette, Opinion Dynamics, Waltham, MA
Dimple Gandhi, PSEG-LI, Melville, NY

ABSTRACT

The most cost-effective energy efficiency programs and those most impactful to ratepayers do not necessarily align. Standard cost-effectiveness tests examine direct effects of programs, but do not consider their deeper impacts on local economies. Using many of the same inputs that are used in conducting cost-effectiveness testing, evaluators can estimate program impacts with more comprehensive economic models. Complementing cost-effectiveness testing with the results of these models can allow for a more detailed understanding of the overall impact of energy efficiency programs than either approach can provide standing alone.

Conducting an economic impact assessment of the effects of an energy efficiency program provides more detail on when and by whom benefits will be realized than typically available through cost-effectiveness analysis. For example, programs with high levels of contractor services may have more impact in the local economy than upstream programs.

This paper presents a discussion of how the results from comprehensive economic impact assessments can provide information on the depth and breadth of program impacts, and can serve as a useful complement to cost-effectiveness results. We review the standard industry practices for cost-effectiveness testing (with a special focus on impacts these analyses miss), present a case study focusing on five years of economic impact assessments conducted for PSEG Long Island, and discuss how the results from these assessments supplement standard cost-effectiveness testing.

Introduction

Program administrators (e.g. utilities or non-profit organizations) operating energy efficiency programs generally seek to address a wide range of goals. Common goals include energy use reduction, peak electric demand reduction, greenhouse gas emissions reduction, and increased customer satisfaction, among others. For a variety of reasons, administrators and/or stakeholders frequently seek to assess whether or not programs are "cost-effective." Cost-effectiveness is a measure of whether an investment's benefits exceed its costs, and is defined in a variety of ways (National Action Plan for Energy Efficiency 2008). Reasons for assessing cost-effectiveness are varied; they can range from a regulatory requirement to ensure benefits to customers outweigh costs to a business need for information to assist in operating programs that offer the most "bang for the buck."

Traditional cost-effectiveness testing is an important tool that allows program administrators to accomplish a number of goals, including meeting regulatory requirements. However, using common cost-effectiveness tests status as the *de facto* standard for assessing whether or not energy efficiency programs are producing positive outcomes may limit the level of quantitative information on the actual, broader effects of energy efficiency programs. Increasingly, program administrators and stakeholders demand more visibility and information on the true effect of energy efficiency programs on ratepayers and local economies.

Using many of the same inputs that are used in conducting traditional cost-effectiveness testing, evaluators can conduct more detailed analyses of the economic impacts of energy efficiency programs. One common approach to these analyses is to use an input-output (I-O) model to model the effects of the program on the economy. While there are several I-O model software applications available, we used the Impact Analysis for Planning (IMPLAN) software package for conducting these analyses.

In this paper, we begin with a brief review of the basics behind cost-effectiveness testing to provide the reader with background on what is typically considered in a benefit/cost ratio developed for an energy efficiency program or portfolio, and compare the methods to those used for economic impact analysis. We continue with a case study of an economic impact analysis Opinion Dynamics conducted for PSEG Long Island (PSEG-LI) using IMPLAN, and close with an examination of how economic impact analyses and cost-effectiveness testing can complement each other, allow for a fuller understanding of the effects of energy efficiency on the economy, and can assist program administrators in program design and implementation.

Background

Cost-Effectiveness Testing Methods

Broadly, cost-effectiveness testing involves a direct comparison of benefits and costs. Evaluators typically present results in the form of a benefit/cost ratio, as shown in Equation 1 below. We consider an investment to be cost-effective if the benefit/cost ratio exceeds 1.0, indicating that the investment's lifetime benefits exceed its lifetime costs.

Equation 1. Basic form of cost-effectiveness tests

$$Benefit/Cost\ Ratio = \frac{Total\ Benefits}{Total\ Costs}$$

Several other forms can also be used to present cost-effectiveness results (depending on the specific form of test chosen), including the total net present value of benefits as well as levelized costs, which present the total costs of the investment on a per-unit of energy basis (California Governor's Office of Planning and Research 2002).

Different choices made about how to define cost-effectiveness can lead to different conclusions about whether an investment (e.g. energy efficiency program or portfolio of programs) meets a given cost-effectiveness standard. Five common cost-effectiveness tests are commonly used for assessment of (California Governor's Office of Planning and Research 2002; National Action Plan for Energy Efficiency 2008):

- Total resource cost test (TRC)
- Societal cost test (SCT)
- Program administrator cost test (PA) (sometimes known as the utility cost test [UCT])
- Participant cost test (PCT)
- Ratepayer impact measure test (RIM)

Each test helps to answer a different question or set of questions. Table 1 provides a high-level summary of the tests.

Table 1. Common cost-effectiveness test summaries

Test	Perspective	Key Question Answered	Summary Approach
Total resource cost test (TRC)	The utility system plus participating customers	Will the utility system costs plus program participant costs decrease?	Includes the costs and benefits experienced by the utility system, plus costs and benefits to program participants.
Societal cost test (SCT)	Society as a whole	Will total costs to society decrease?	Includes the costs and benefits experienced by society as a whole.
Program administrator cost test (PA)/ Utility cost test (UCT)	The utility system	Will PA/utility costs decrease?	Includes the costs and benefits experienced by the utility system.
Participant cost test (PCT)	Customers who participate in an efficiency program	Will program participants' costs decrease?	Includes the costs and benefits experienced by the customers who participate in the program.
Ratepayer impact measure test (RIM)	Impact on rates paid by all customers	Will utility rates decrease?	Includes the costs and benefits that will affect utility rates, including the utility system costs and benefits plus lost revenue.

Source: National Efficiency Screening Project 2017

Because each test is designed to answer a specific question, none of the commonly-used tests consider benefits and costs from all perspectives. Instead, each test is limited to a consideration of benefits and costs from a single viewpoint. For example, the PCT, representing the perspective of a program participant, considers incentive payments from the utility to a participant as a benefit, while the PA test, representing the perspective of a program administrator, considers it as a cost. The TRC test, meanwhile, generally does not include incentives in its calculus, as incentives are considered zero net transfers (National Action Plan for Energy Efficiency 2008).[1]

All of these tests consider key benefits and costs depending on their perspective. However, these tests generally do not explicitly consider the broader economic impacts of energy efficiency programs, such as employment levels, tax revenues, and overall economic output (Synapse Energy Economics, Inc. 2012).[2]

Economic Impact Analysis Methods

The economic impact analysis we describe in this paper is based on an I-O model we implement in IMPLAN. An input-output model treats an economy as a set of linked economic sectors that are codependent. For this analysis, we defined a set of "events," treated as a change in a specific set of sectors, and input them into the model. Because the sectors are linked, cascading effects occur. Figure 1 provides a visual example of how effects propagate through various sectors.

[1] Note that in practice, TRC costs may consider the difference between paid incentives and total customer surcharges in funding an energy efficiency program. Such a difference occurs due to program overhead costs and other program spending that does not directly result in an incentive payment to a customer. However, paid incentives are not *separately* considered in a TRC analysis.

[2] Conceptually, the perspective of the SCT includes these effects – however, actual application of the SCT rarely includes evaluated economic effects.

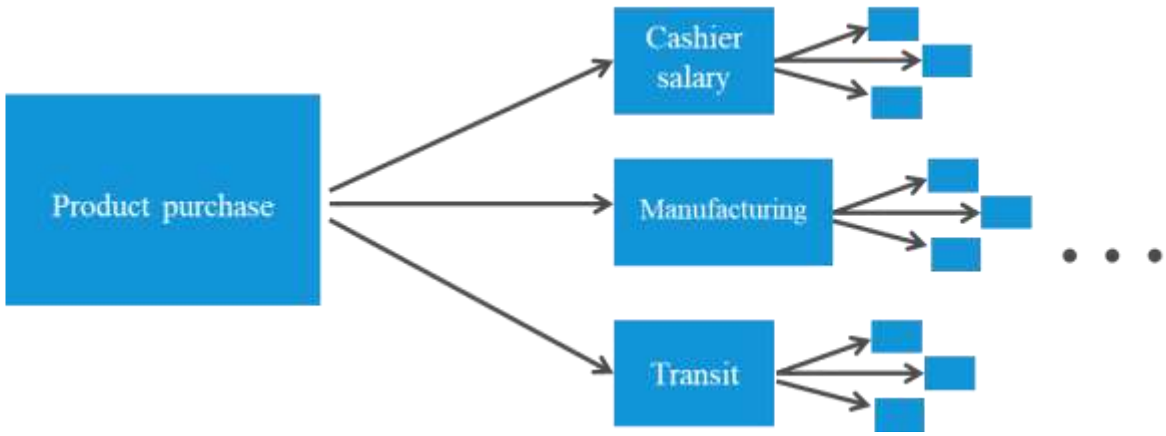

Figure 1. Input-output modeling overview.

In this analysis, we used IMPLAN software to analyze the economic impact of energy efficiency programs. With information on program spending and costs, and the IMPLAN software, we built a static model for the effects of program spending based on a matrix of underlying relationships among various sectors, including households, industries, and government. Assumptions about these relationships are an underlying component of the IMPLAN software, based on localized economic and employment data from sources such as the Bureau of Economic Analysis Regional Economic Accounts and the Bureau of Labor Statistics Census of Employment and Wages. These assumptions are also specific to the local economy under study, containing information on how spending is "multiplied" to multiple local sectors, as well as what portion of spending may extend beyond the local economy.[3]

IMPLAN uses a proprietary set of sectors, but generally sectors are similar to those defined in sector schema such as Standard Industrial Classification (SIC) or North American Industry Classification (NAICS).[4] The model accounts for spending going to a specific sector (e.g., contractors), as well as expenditures from a specific sector (e.g., household spending on incremental measure costs). For example, the stream of residential *household* benefits accounts for *participant* bill savings, *participant* incremental measure cost, the bill surcharge to fund energy efficiency programs, and rebate payments from the program to participants, where participant bill savings persist for as long as the expected measure life of installed measures. Similarly, the stream of *commercial* benefits accounts for *participant* bill savings, *participant* incremental measure cost, and the bill surcharge to fund energy efficiency programs, as well as any program spending related to that sector.

Figure 2 provides a visual model of how the model accounts for flows of costs and benefits.

[3] It is worth noting that IMPLAN makes a number of simplifying assumptions, such as fixed prices, no substitution effects, no supply constraints, and no changes in competitiveness or other demographic factors. However, such assumptions are not worrisome in assessing short-term impacts, in which the focus is on attaining a snapshot of a regional economy. This methodology is deemed to be an effective tool for the evaluation of impacts that do not shift economic equilibrium conditions and has been used successfully in economic impact evaluations of a number of different energy efficiency programs.

[4] IMPLAN defines 536 sectors. NAICS provides a much more granular level of detail than IMPLAN's defined sectors if desired, but broad sector categorization is similar between the systems.

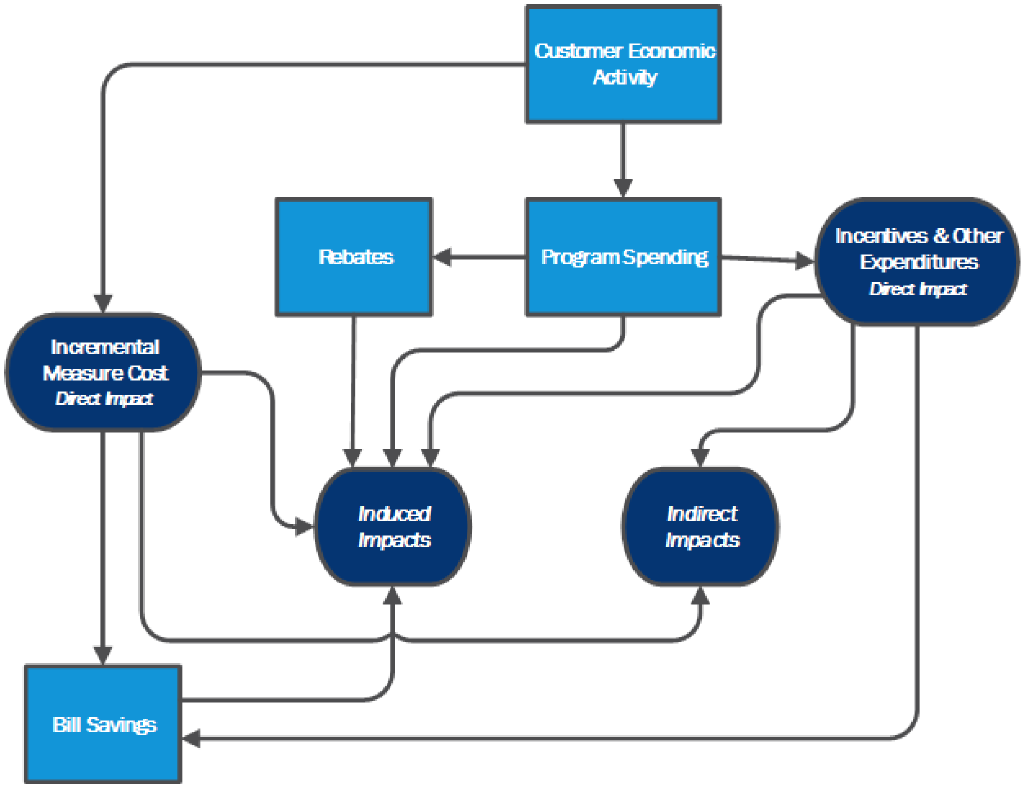

Figure 2. Visual model of economic impact analysis.

Each item in the visual model represents a dollar amount either defined as an input into the model (boxes with square corners) or outputs produced by the model (boxes with rounded corners). The model produces a number of outputs; in particular, it quantifies the portfolio's economic impact in terms of overall economic output (value-added portion of sales) and employment or jobs created. The various terms in this model are defined below.

- **Customer Economic Activity:** This box represents the base level of customer spending before program intervention.
- **Program Spending:** This box represents the total amount of program spending in the year of analysis.
- **Rebates:** This box represents the total amount of program spending in the year of analysis on rebates moving directly from the program to program participants.
- **Direct Impacts:** Direct impacts are equal to the localized portion of direct spending from energy efficiency programs. Direct impacts include the following:
  - *Incentives & Other Expenditures*: This box represents the balance of the program spending after rebate expenditures and program staff salaries. This box includes the cost of, for example, measures purchased by the program as part of direct installation program spending, installation costs, program spending on marketing and advertising, and incentives paid directly to contractors. The portion of this spending amount that occurs within the area of analysis is treated by the model as a direct impact on the local economy.
  - *Incremental Measure Cost*: This box represents the incremental measure cost expenditures paid by program participants toward program measures. The portion of this spending amount that occurs within the area of analysis is treated by the model as a direct impact on the local economy. It is important to note that this dollar amount

represents total incremental cost expenditures *attributable to the program* – in other words, we consider only net incremental spending.

- **Bill Savings:** This box represents the bill savings resulting from installation of efficient equipment incentivized through the program.
- **Indirect Impacts:** Indirect impacts are determined by the amount of the direct impacts spent within the area of analysis on supplies, services, labor, and taxes. For example, indirect impacts would include money (and associated employment) transferred to local businesses by contractors for supplies needed to install energy efficiency measures, such as if a local wholesaler of HVAC equipment increased sales and added additional workers to help meet the growing demand for the company's products.
- **Induced Impacts:** Induced impacts are associated with the effects of the direct and indirect impacts on household and business proprietors' income, for example, money expended on Long Island by households or business proprietors benefiting from energy efficiency savings and direct and indirect program spending, such as if the employee of an HVAC contractor used his or her income (increased by work through a residential HVAC program) to purchase a car, which stimulates business at the local car dealership.

To prepare the model, we aggregated spending and cost data indicated above at a sector level for each year and entered this information into the software. For example, we begin with incentives paid, incremental costs, and bill savings resulting from an energy efficiency project at the project level. We assign each project to a sector, as defined above, and aggregate total incentives, incremental costs, and bill savings to the sector level. We also incorporate program bill surcharges at the sector level by distributing the total surcharges paid across all sectors of the economy according to each sector's share of electricity sales.

Comparison of Methods

The assumptions made in common cost-effectiveness tests are reasonable, but each provides a limited perspective on the actual effects of energy efficiency programs and uses a number of simplifying assumptions. For example, when implementing a TRC test, we make an assumption that the net effect of incentive payments is zero. We contrast this to our economic impact analysis method, which attempts to account for all streams of benefits and costs (benefits and costs modeled are similar to a combination of those considered in the PA and TRC tests). In this method, program costs are allocated across the economy, while we simultaneously model increased spending in the economy and incentive payments as a positive effect in various sectors.

The model considers both positive and negative impacts of the energy efficiency program under study. One useful example is the bill surcharge imposed on households and businesses to fund the program. Our model considers this as a negative effect on households and businesses from the status quo. In other words, we model a decreased level of household and business spending based on the bill surcharge, which creates negative economic impacts (including employment) due to decreased spending. The model *also* considers the positive impacts of this surcharge; namely, the program spending funded by the surcharge, which creates *positive* economic impacts spurred by financial transfers from the program administrator to participants, additional customer spending on energy efficient products, and other economic activity.

While the total streams of costs (the bill surcharge) and benefits (program spending, incentive payments, etc.) are equal, their distribution throughout the economy can produce unequal effects, as spending (resulting from program administration) in some economic sectors can produce a significant "multiplier" effect that causes additional economic activity not captured in the TRC test's assumption of zero net impact from incentive payments.

As the above alludes to, cost-effectiveness testing also does not reflect the same level of granularity as the economic impact analysis we describe. Standard practice around cost-effectiveness testing is not specific to the variations present in local economies. Energy efficiency programs implemented in individual service territories may have significantly different localized effects depending on the business structure of each service territory. Two programs that have the same expenditures and similar benefit/cost ratios could have different economic impacts based on their implementation design (for example, incentives vs. contractor rebates vs. direct install) and the measure mix (for example, weatherization programs create more economic activity among contractors and other labor-intensive industries, while HVAC or lighting programs create more economic activity among equipment manufacturers). Our analyses to date have not conducted substantial program-level analysis, but we plan to examine these differences in more detail moving forward.

Similarly, two identical programs operated in different geographic jurisdictions might realize different economic impacts based on the differences in local economies (Cadmus 2014). For example, a service territory that has a significant number of energy service providers located within it may realize significant local benefits from the implementation of energy efficiency programs, while a service territory without a significant number of these providers may funnel benefits to other regions.

While the data analyzed in our economic impact analysis method are similar to those considered in cost-effectiveness testing, the model incorporates significantly increased granularity by allocating data at an economic sector level and utilizing localized economic data that reflects the specific characteristics of the study area under consideration.

Finally, economic impact analyses can produce results that are richer in detail than the typical outputs of cost-effectiveness analyses. Using the detailed economic models that are built as part of the analysis, we can assess the effects of economic activity caused by energy efficiency programs on specific economic sectors, identifying where the benefits of program activity are being realized. Economic impact analysis can also be used to quantify job creation as a result of investments into energy efficiency. These results are a powerful complement to cost-effectiveness analyses.

Case Study

Background Information

PSEG-LI has administered a portfolio of energy efficiency programs on Long Island since 2014; previous energy efficiency programs were implemented in a similar form on Long Island by the Long Island Power Authority (LIPA) from 2009 to 2013.[5,6] Opinion Dynamics conducts annual program evaluations of the portfolio for PSEG-LI. As part of the annual evaluation, we assess the cost-effectiveness of the PSEG-LI portfolio. We have historically conducted both TRC and PA tests for PSEG-LI to provide multiple perspectives on program cost-effectiveness. Moving forward, per guidance from the New York Public Service Commission, we will be conducting a SCT test as the primary measure of cost-effectiveness (NY PSC 2016).

Beginning in 2011, we have also conducted yearly economic impact analyses to quantify the benefits of PSEG-LI's program spending on economic output and employment on Long Island.[7] The

[5] Throughout the remainder of this paper we will refer to both the LIPA and PSEG-LI's portfolios of programs as "PSEG-LI's programs" for ease of readership; the reader will note that while the utility name changed, Opinion Dynamics has continuously evaluated these programs in their present form since 2009.

[6] LIPA operated energy efficiency programs in a different structure prior to 2009.

[7] To provide PSEG-LI with the estimated 2009 and 2010 economic impacts of their program implementation, we extrapolated 2011 results to past levels of program spending in those years. Because this analysis was not tailored to individual program years, we do not present its results here.

economic impact analysis quantifies the first-year and 10-year impacts of PSEG-LI's 2016 energy efficiency portfolio on the economies of Nassau and Suffolk counties, the two counties in New York State that make up PSEG-LI's service territory.

Cost-Effectiveness Findings

Table 2 presents the cost-effectiveness results by year for the PSEG-LI energy efficiency portfolio. We find the PSEG-LI energy efficiency portfolio to be cost-effective in all years of operation, using both the TRC and PA tests.[8] We note some year-to-year variation in cost-effectiveness results, primarily reflecting differences in program implementation in early years of program, but as the portfolio has matured, we have found consistent TRC benefit/cost ratios of approximately 2, and consistent PA benefit/cost ratios of slightly over 3.

Table 2. PSEG-LI cost-effectiveness by year, 2009-2015

Year	Total Resource Cost Benefit/Cost Ratio	Program Administrator Benefit/Cost Ratio
2009	2.2	N/A
2010	4.0	6.1
2011	2.7	4.4
2012	1.9	2.9
2013	1.8	3.1
2014	2.1	3.4
2015	2.2	3.3

Economic Impact Analysis Results

Table 3 presents a basic summary of first-year results from our analysis of PSEG-LI's portfolio between 2011 and 2015, including full-time equivalent (FTE) jobs. Program investment, provided by PSEG-LI, is presented here as a comparative tool; all other information in the table is a result of modeling. This analysis considers only the effects noted in the year programs are implemented; in other words, all future benefits or costs to customers (e.g., energy savings) beyond the year of program operation under analysis are not considered. The "multiplier" column shows the ratio of total first-year economic output as a result of the programs to program costs, similar to a benefit/cost ratio produced via a cost-effectiveness test.

[8] The PA test was not conducted in 2009.

Table 3. PSEG-LI first-year economic impacts

Year	Program investment	*Direct effects*	*Indirect & induced effects*	Total economic output	Multiplier ($s of economic output per $ of program investment)	FTEs (Jobs)	FTEs/$1M
2011	$46.8	*$48.6*	*$13.0*	$61.6	1.3	445	9.5
2012	$74.8	*$79.2*	*$2.4*	$81.6	1.1	609	8.1
2013	$80.4	*$84.3*	*$0.7*	$85.0	1.1	542	6.7
2014	$70.3	*$65.7*	*$8.2*	$73.9	1.1	473	6.7
2015	$70.5	*$70.4*	*$7.1*	$77.5	1.1	582	8.3

Source: Opinion Dynamics 2012-2016
Note: Direct, indirect, and induced effects are subcategories of total economic output.
Note: All dollar values in millions of dollars.

We find the first-year economic impact multipliers presented in Table 4 are all over 1.0, indicating that even when ignoring the persistent benefits that continue to accrue to program participants throughout the life of measures installed through PSEG-LI's programs, the portfolio of programs has a net positive impact on the Long Island economy in each year of operation. Direct effects alone have a net positive effect or nearly net positive effect in all years but one in our analysis. We also find that the program creates between 6.7 and 9.5 new FTEs in the first year per million dollars of program investment.

Table 4 presents a similar summary of ten-year results from our analysis of PSEG-LI's portfolio between 2011 and 2015. This analysis considers all effects noted in a ten-year period from operation of the portfolio in the year under analysis.

Table 4. PSEG-LI ten-year economic impacts

Year	Program investment	*Direct effects*	*Indirect & induced effects*	Total economic output	Multiplier ($s of economic output per $ of program investment)	FTEs (Jobs)	FTEs/$1M
2011	$46.8	*$48.6*	*$106.7*	$155.3	3.3	1,175	25.1
2012	$74.8	*$79.2*	*$62.3*	$141.5	1.9	1,086	14.5
2013	$80.4	*$84.3*	*$68.9*	$153.3	1.9	1,096	13.6
2014	$70.3	*$65.7*	*$95.2*	$160.9	2.3	1,166	16.6
2015	$70.5	*$70.4*	*$107.7*	$178.1	2.5	1,362	19.3

Source: Opinion Dynamics 2012-2016
Note: Direct, indirect, and induced effects are subcategories of total economic output.
Note: All dollar values in millions of dollars.

The reader will note that the ten-year impacts are substantially greater than the first-year effects in terms of both total economic output and FTEs. This is the case because all modeled negative impacts of the energy efficiency program (e.g., the bill surcharge funding a given program year that decreases customer spending) occur in the year of program implementation. However, some positive impacts (namely bill savings) continue to accumulate in future years. These effects are included in the indirect & induced effects column in Table 4.

Our overall findings for PSEG-LI show that the cumulative effects of program investment from 2009 to 2015 will return a total of $1.14 billion[9] to the Long Island economy and result in 7,354 additional FTEs from 2009 to 2024.

[9] In 2015 dollars.

Discussion

Comparison of Cost-Effectiveness Testing and Economic Impact Analysis Results

The economic impact multipliers derived in the above analysis are not exactly comparable to a benefit/cost ratio. However, we can conceptualize the multipliers in a similar manner - a multiplier greater than 1 means that every dollar of program spending leads to more than a dollar of economic output, similar to a benefit/cost ratio's comparison of overall program benefits and costs.

It is worth noting that cost-effectiveness analyses typically are run over the entire life of all measures installed through an energy efficiency program, and therefore provide the full lifetime net present value of benefits and costs considered. In this case, we conducted our economic impact analysis over a ten-year period. While most measure benefits are likely accounted for, measures with a long lifetime installed through PSEG-LI programs, such as HVAC or building envelope measures, continue to accumulate value beyond the horizon of our analysis. As such, our analysis is likely a conservative estimate of the lifetime impacts of PSEG-LI's energy efficiency programs. Figure 3 presents a comparison of cost-effectiveness and economic impact results for PSEG-LI's energy efficiency portfolio.

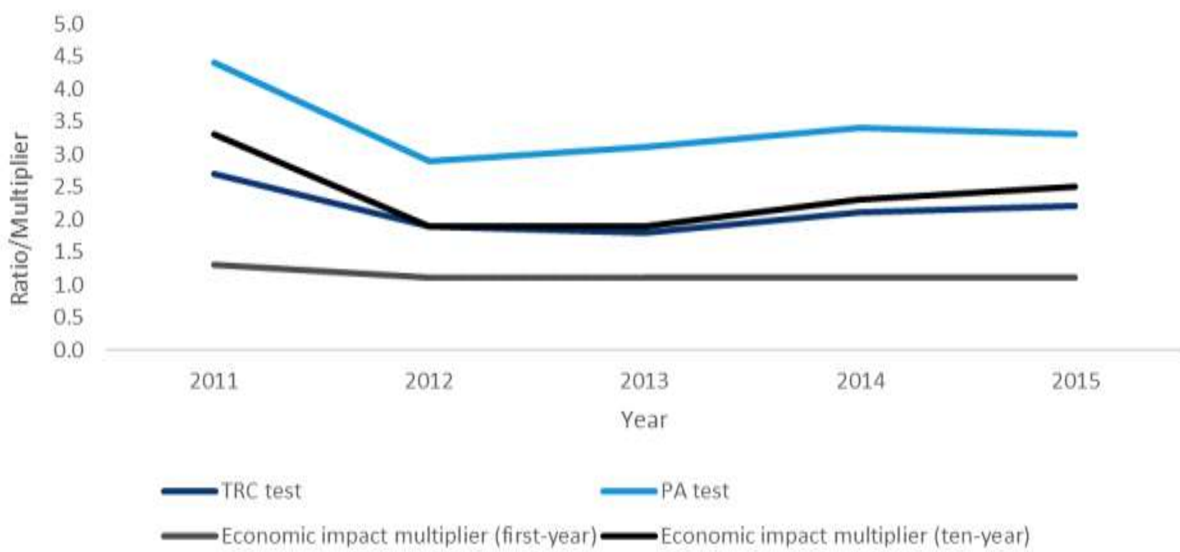

Figure 3. Comparison of PSEG-LI economic impact multipliers and cost-effectiveness results, 2011-2015. *Source*: Opinion Dynamics 2012-2016.

In our analysis, we see a generally comparable pattern of variation in benefit/cost ratios and ten-year multiplier – in particular, it is notable that the ten-year economic impact multiplier and TRC benefit/cost ratio align very closely. This is an indication that the economic impact model is likely capturing the same year-to-year variation exhibited in the cost-effectiveness results. The first-year economic impact multiplier is generally flat, which indicates that variation in the ten-year economic impact analysis multipliers is likely driven largely by the measure savings achieved in years 2-10. Differences in the economic impact multipliers and cost-effectiveness tests are likely driven by a combination of multiple factors; the differences in inputs considered, the time horizon of the analyses conducted, and the model-based effects that reflect the specificities of the Long Island economy in the case of the economic impact multipliers.

Conclusions

Cost effectiveness testing is well-ensconced as standard practice in the energy efficiency industry, a practice likely to continue well into the future. While we observe some variation reflective of differences in the analytic methodology, we generally find that the high-level results from our economic impact analysis align well with the typical cost-effectiveness tests used to assess the performance of energy efficiency programs. However, in addition to producing the basic multipliers we report in this paper, economic impact analysis is a powerful and unique tool for characterizing the detailed effects of energy efficiency programs at a much deeper level than traditional cost-effectiveness analysis.

First, economic impact analysis allows for a more concrete quantification of the economic impacts of energy efficiency programs on a local area. Using actual evaluated program expenditures, savings, and other costs and benefits allows for a rigorous and accurate assessment of the actual effects of programs, including FTEs added as a result of program investments. This is a powerful tool for a program administrator to use for marketing and regulatory purposes.

Economic impact analysis also reflects the structural composition of the economy and energy efficiency programs in a way that cost-effectiveness testing does not. Utilizing an economic impact analysis should give program administrators increased confidence that the unique characteristics of their service territory are being treated properly in analysis.

Finally, economic impact analyses allow for a more granular assessment of where in the economy the impacts of energy efficiency are felt. While such an analysis was outside of the scope of work conducted in the case study this paper examines, results can be examined down to the economic sector level, showing estimates of, for example, where in the economy FTEs were added as a result of energy efficiency programs. Examples of this type of analysis can be noted elsewhere in the literature (Cadmus 2014).

As energy efficiency programs evolve in the marketplace, they are increasingly being judged on more inclusive cost-effectiveness tests, such as the SCT. This reflects a desire for an analysis framework that goes beyond the current status quo to show the complete and full impacts of energy efficiency. The New York PSC writes: "New York's clean energy goals are set in recognition of the effects of pollutants and climate change on society as a whole, and only the SCT would both properly reflect those policies and create a framework for meeting those goals" (New York Department of Public Service 2015). While this statement is targeted primarily at the inclusion of non-energy benefits in cost-effectiveness testing, it rings similarly true when examining the deeper impacts of energy efficiency on local economics. In the absence of the ability to include these impacts of energy efficiency in a standard cost-effectiveness test, a model-based economic impact analysis is a powerful complementary analysis tool that can help program administrators more fully recognize the effects of investments in energy efficiency on local economic outcomes.

Acknowledgements

This paper is based on work conducted for PSEG Long Island and the Long Island Power Authority.

References

California Governor's Office of Planning and Research. July 2002. "California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects." <http://www.calmac.org/events/spm_9_20_02.pdf>, accessed April 12, 2017.

Koson, Matthew, Stephen Grover, Maggie Molina, and Max Neubauer. 2014. "Saving Energy, Lowering Bills, and Creating Jobs: An Economic Impact Analysis of Two Statewide Energy Efficiency Program Portfolios." <http://aceee.org/files/proceedings/2014/data/papers/8-756.pdf>, accessed April 23, 2017.

National Action Plan for Energy Efficiency. 2008. "Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers". Energy and Environmental Economics, Inc. and Regulatory Assistance Project. <www.epa.gov/eeactionplan>, accessed March 15, 2017.

National Efficiency Screening Project. 2017. "National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources." <https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf>, accessed May 18, 2017.

New York Department of Public Service. July 1, 2015. "Staff White Paper on Benefit-Cost Analysis in the Reforming Energy Vision Proceeding." <https://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/c12c0a18f55877e785257e6f005d533e/$FILE/Staff_BCA_Whitepaper_Final.pdf>, accessed April 24, 2017.

Opinion Dynamics and Energy & Resource Solutions, Inc. May 18, 2012. "LIPA Efficiency Long Island – 2011 Annual Evaluation Report."

Opinion Dynamics and Energy & Resource Solutions, Inc. June 2013. "LIPA Efficiency Long Island and Renewables Portfolio – 2012 Annual Evaluation Report."

Opinion Dynamics and Energy & Resource Solutions, Inc. May 28, 2014. "Long Island Power Authority Efficiency Long Island and Renewable Energy Portfolio – 2013 Annual Evaluation Report."

Opinion Dynamics. July 30, 2015. "Efficiency Long Island and Renewable Energy Portfolios – 2014 Annual Evaluation Report."

Opinion Dynamics. July 12, 2016. "Efficiency Long Island and Renewable Energy Portfolios – 2015 Annual Evaluation Report."

Synapse Energy Economics, Inc. November 2012. "Energy Efficiency Cost-Effectiveness Screening: How to Properly Account for 'Other Program Impacts' and Environmental Compliance Costs." <http://www.synapse-energy.com/sites/default/files/SynapseReport.2012-11.RAP_.EE-Cost-Effectiveness-Screening.12-014.pdf>, accessed June 2, 2017.

State of New York Public Service Commission. January 21, 2016. "Order Establishing the Benefit Cost Analysis Framework."

The Cadmus Group, Inc. 2014. "Energy Pro3: The Economic Impact of Energy Efficiency Investments in the Southeast." <http://www.seealliance.org/wp-content/uploads/SEEA-EPS-EE-Report.pdf>, accessed April 12, 2017.