Optimal ENERGY Integrated Energy Resources

# Pennsylvania 2013 – 2018 Energy Efficiency Goals

Prepared for

PennFUTURE

by:

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## EXECUTIVE SUMMARY

On October 15, 2008 Act 129 was signed into law in Pennsylvania. Act 129 requires that Pennsylvania utilities deliver energy efficiency programs that reduce their electric load by 1% by May 31, 2011 and by 3% by May 31, 2013. It also requires a total peak demand reduction of 4.5% by May 31, 2011. As of the end of the second program year, Act 129 efficiency programs have already lowered the state's electric load by 2,073 GWh, 41% higher than the goal set by Act 129. This represents $278 million in annual savings for electric ratepayers, or a present value $2.3 billion over the expected lives of the efficiency measures, for an upfront cost of $281 million. This is a present value of about $8 in ratepayer savings for every dollar spent on the program. The efficiency achieved to date will also create a lifetime emissions reduction of 23 million tons of carbon dioxide equivalent, equal to taking 4 million cars off the road for a year, and create over 4,000 jobs. These emissions reductions will also improve Pennsylvania residents' health and reduce ratepayer risk associated with compliance costs for any future air quality regulations. Further, the utilities have been able to achieve this reduction for a levelized cost of 1.6 cents per kWh, compared to a levelized cost of around 10 cents per kWh for conventional coal generation. This ensures that, in the medium to long term, all Pennsylvania ratepayers will benefit from ongoing efficiency that delays or eliminates the need for new power plants and transmission upgrades.

Clearly, the Act 129 programs have been very successful, highly cost-effective, and have already brought significant benefits to Pennsylvania and Pennsylvania's electric ratepayers. As a result, we recommend extending its programs for another 5 years, through May 31, 2018.

In the Potential Analysis section of the report, we first characterize the total amount of cost-effective, or "economic," potential in the state of Pennsylvania based on a forecast of growth in statewide electricity consumption and a review of results of similar potential studies in various jurisdictions. As shown in the table below, we find that, with remarkable consistency, other studies have found the economic potential at around 25% of sales.

**Table E1 – Economic Potential by State**

| | Residential | | Commercial | | Industrial | |
|---|---|---|---|---|---|---|
| | GWh | MW | GWh | MW | GWh | MW |
| Pennsylvania (2009)* | 30% | 35% | 29% | 35% | 16% | 35% |
| Virginia (2008) | 26% | 25% | 28% | 25% | 25% | 25% |
| RI Opportunity Report (2008) | 28% | 30% | 28% | 35% | 14% | 25% |
| New Jersey (2004) | 19% | N/A | 19 % | N/A | 7.92% | N/A |
| Georgia (2005) | 21% | 20% | 22% | 18% | 15% | 15% |
| North Carolina (2006) | 20% | N/A | 22% | N/A | 17.5% | N/A |
| Texas(2007)* | 32% | 12.5%** | 39% | 12.5% | 26% | 12.5% |
| Connecticut (2009) | 32% | N/A | 42% | N/A | 33% | N/A |
| Kansas (2008) | 35% | 38% | 34% | 38% | N/A | N/A |
| **MEDIAN** | **26%** | **28%** | **28%** | **25%** | **16%** | **25%** |

* Did not break out peak demand by Sector, assumed to be equal across sectors

**Demand response only

For purposes of this report, we assume the median reduction in sales for the residential, commercial, and industrial sector represents the economic potential in Pennsylvania. This represents a reasonable upper bound on possible efficiency efforts. We find that, in 2018, total economic potential is equal to approximately 31,500 GWh of electricity savings and approximately 10,800 MW in peak demand reduction.

Next, the report assesses possible savings goals for the next five year period of efficiency programs, both if the current spending cap were left in place (the constrained scenario), and if the cap were removed (the unconstrained scenario). We find that current saving goals and spending caps already require a cost per kWh saved at the low end of similar programs, and therefore recommend leaving savings goals in the constrained scenario unchanged. These goals would save approximately 1% of electricity sales annually, or about 5% in 2018. This represents an annual load reduction of over 7,300 GWh, annual ratepayer savings of $932 million (present value of $7.8 billion over the lives of the measures), a lifetime reduction in emissions equivalent to taking 14 million cars off the road, and a net lifetime gain of over 14,000 jobs. Energy reduction in the constrained scenario for 2015 and 2018 is shown in Table E-2

**Table E-2: 2- and 5- Year Cumulative Energy Goals for Constrained Scenario**

| | 2011-2012 Sales (GWh) | 2015 (GWh) | % 2011-12 Sales | 2018 (GWh) | % of 2011-2012 Sales |
|---|---|---|---|---|---|
| Duquesne | 14,115 | 282 | 2.0% | 704 | 5.0% |
| Met-Ed | 14,138 | 297 | 2.1% | 743 | 5.3% |
| Penelec | 14,310 | 288 | 2.0% | 720 | 5.1% |
| Penn Power | 4,576 | 95 | 2.1% | 239 | 5.3% |
| PPL | 37,540 | 764 | 2.0% | 1,910 | 5.2% |
| PECO | 39,385 | 788 | 2.0% | 1,969 | 5.2% |
| West Penn | 20,379 | 419 | 2.1% | 1,047 | 5.2% |
| **Total** | **144,442** | **2,933** | **2.0%** | **7,332** | **5.2%** |

Many states have begun to recognize the highly cost-effective nature of efficiency programs, and in response have been aggressively increasing their spending and savings targets. Currently, leading states are achieving annual savings of 2% or more. Under the unconstrained scenario, it is assumed that the budget cap is lifted and that savings targets are increased to 2% of load for the 2015-2016 program year, and maintain this same level of savings through 2018. Under this scenario, cumulative annual savings would reach nearly 9% in 2018, equal to a load reduction of almost 13,000 GWh. Since the economic potential in the state was found to be about 31,500 GWh in 2018, there is no danger of this level of program activity exhausting the cost-effective efficiency opportunities. This represents annual ratepayer savings of $1.6 billion (present value of $13.5 billion over the lives of the measures), a lifetime reduction in emissions equivalent to taking 25 million cars off the road, and a net lifetime gain of over 40,000 jobs. Two and five year energy reduction targets for the unconstrained scenario are shown in Table E-3:

**Table E-3: 2- and 5- Year Cumulative Energy Goals for Unconstrained Scenario**

| | 2015 Savings (GWh) | | | | | 2018 Savings (GWh) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Res | Com | Ind | Total | % of 2011-2012 Sales | Res | Com | Ind | Total | % of 2011-2012 Sales |
| Duquesne | 121 | 188 | 79 | 392 | 2.75% | 384 | 599 | 252 | 1,235 | 8.75% |
| Met-Ed | 156 | 84 | 149 | 396 | 2.75% | 495 | 268 | 474 | 1,237 | 8.75% |
| Penelec | 128 | 101 | 164 | 404 | 2.75% | 407 | 322 | 522 | 1,252 | 8.75% |
| Penn Power | 47 | 36 | 44 | 129 | 2.75% | 148 | 114 | 139 | 400 | 8.75% |
| PPL | 392 | 302 | 338 | 1,059 | 2.75% | 1,248 | 962 | 1,075 | 3,285 | 8.75% |
| PECO | 393 | 241 | 449 | 1,134 | 2.75% | 1,250 | 767 | 1,429 | 3,446 | 8.75% |
| West Penn | 204 | 140 | 217 | 577 | 2.75% | 648 | 445 | 691 | 1,783 | 8.75% |
| **Total** | **1,439** | **1,093** | **1,440** | **4,091** | **2.75%** | **4,580** | **3,477** | **4,582** | **12,639** | **8.75%** |

Finally, the report looks at the current policy environment in Pennsylvania and makes suggestions that could improve the quality and effectiveness of the state's efficiency programs. Some suggestions include:

- **Modify the implementation details of the TRC test** – this includes allowing fossil fuel benefits, using a lower discount rate, allowing benefits beyond a15-year time frame, including an estimate of demand reduction induced price effects (DRIPE) in the avoided costs, and including an externality/risk reduction adder.
- **Lift the 2% spending cap** – the spending cap currently acts as a severe limitation on the amount of efficiency allowed and represents significant forgone economic, environmental, and health benefits for the state of Pennsylvania. Further, since the cap is tied to 2% of 2005-2006 sales and does not increase with inflation or with increases in utility revenue over time, the efficiency procured as a percent of current sales will steadily deteriorate over time. In other words, the current spending cap forces utilities to become less aggressive with efficiency over time, rather than more aggressive as is the trend in almost all other states.
- **Explore implementing decoupling or performance incentive** – decoupling and performance incentives are gaining recognition as ways to allow efficiency to compete more fairly with supply side alternatives. Decoupling removes utility disincentives for investing in efficiency, while performance incentives may create a positive incentive for successful utility efficiency programs.
- **Set targets based on net savings rather than gross savings** - savings targets based on gross savings create a perverse incentive for utilities to focus too much of their effort on promoting technologies such as basic CFLs, which save a lot of energy and are highly cost-effective, but that are now being widely adopted in the marketplace and therefore have high freerider rates. This is especially true in states such as Pennsylvania with no decoupling or lost revenue recovery – freeriders are not only much easier to reach, but also avoid lost revenue.
- **Allow implementation flexibility** – currently, Pennsylvania utilities have limited ability to 1) switch funds between programs within the same customer class; 2) eliminate a measure that is underperforming; 3) change the rebate levels for a measure; or 4) change measure eligibility conditions. We believe that, like a successful business, a successful efficiency program needs to be able to respond to changing market conditions and learn from program experience in real time without the need for lengthy regulatory review.
- **Discourage pursuit of the only the cheapest savings** - Pennsylvania's focus on gross savings rather than net savings as well as the fairly cheap savings needed to achieve the goals may require utilities to limit their efforts to only the very least expensive efficiency opportunities, often referred to as 'cream-skimming.' We recommend that, in order to reduce this, the budget cap should be lifted and saving targets should be based on net savings rather than gross savings. Further, any future performance incentives could be structured in a way as to discourage cream-skimming.

# INTRODUCTION AND SUMMARY OF FINDINGS

On October 15, 2008 Act 129 was signed into law in Pennsylvania. Act 129 requires that Pennsylvania utilities deliver energy efficiency programs that reduce their electric load by 1% by May 31, 2011, and by 3% by May 31, 2013. It also requires a total peak demand reduction of 4.5% by May 31, 2013. As of the end of the second program year, Act 129 efficiency programs have already lowered the state's electric load by 2,073 GWh, 41% higher than the goal set by Act 129. This represents $278 million in annual savings for electric ratepayers, or $3.6 billion over the expected lives of the efficiency measures, for an upfront cost of $281 million, an investment which will net Pennsylvania over 4,000 jobs. The efficiency achieved to date will also create a lifetime emissions reduction of 22 million tons of carbon dioxide equivalent, equal to taking 4 million cars off the road for a year. These emissions reductions will improve Pennsylvania resident's health, and reduce ratepayer risk associated with future compliance costs for any future air quality regulations.[1] Further, the utilities have been able to achieve this reduction for a levelized cost of 1.6 cents per kWh, compared to a levelized cost of around 10 cents per kWh for conventional coal generation.[2] This ensures that, in the medium to long term, all Pennsylvania ratepayers will benefit from ongoing efficiency that lessens or eliminates the need for new power plants and transmission upgrades.

Clearly, the Act 129 programs have been very successful, highly cost-effective, and have already brought significant benefits to Pennsylvania and Pennsylvania's electric ratepayers. Likewise, failure to extend the programs would result in significant forgone benefits. This study finds that, even with the efficiency spending cap left in place, energy savings over 5 years would equal about 5% of load, create, by 2018, $932 million in annual electric bill saving, reduce Pennsylvania emissions by 80 million tons carbon dioxide equivalent over the lifetime of the efficiency measures (the equivalent of taking 14 million cars of the road), and create over 14,000 jobs. If the spending cap is removed and the efficiency programs are allowed to scale up to 2% annual savings by the end of the five-year program, the annual electric bill savings would reach $1.6 billion, there would be a lifetime emissions reduction of 138 million tons of carbon dioxide equivalent (the equivalent of taking 25 million cars off the road), and over 40,000 jobs would be created.

Further, as detailed below, it is clear that energy efficiency provides significant economic and environmental benefits to society. In fact, based on numerous attempts by other analysts to quantify the indirect benefits of efficiency, it is likely that the benefits not included in the typical cost-effectiveness test actually exceed those that are included. As a result, we conclude that Act 129 has already created significant tangible and intangible benefits to the state, and highly recommend extending its programs for another 5 years, through May 31, 2018.

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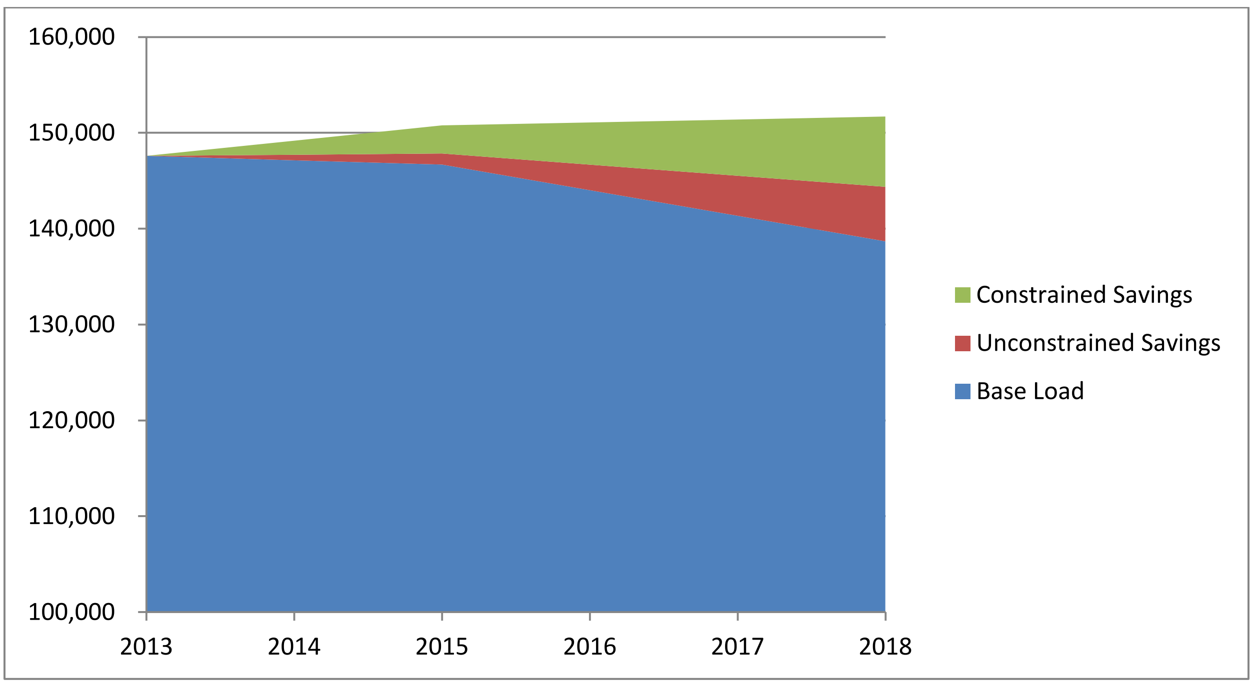
[1] Cars off the road numbers come from EPA's carbon equivalent calculator. Job numbers assume 15 jobs per one million dollar spent on efficiency. This on the low side of the range of available estimates, and is consistent with the ACEEE potential study done for Pennsylvania. Throughout the report, one "job" represents one full time job for one year. See section on economic benefits.

[2] Assumes a discount rate of 7% and an average measure life of 13 years

As presented in the next section, the total economic (cost-effective) potential in Pennsylvania in 2018 is about 31,500 GWh, or 21% of the projected 2018 load. This is well above what any conceivable program would actually achieve in a 5-year period. We also look at the cost of savings that must be achieved in order to reach the savings goals within the spending cap (the "budget-constrained scenario"), and conclude that, while the targets are achievable, there is not much room to increase annual savings goals beyond the current savings requirements of 1% of sales per year, unless the 2% spending cap is revoked.

We next estimate potential savings in an "unconstrained scenario," if the spending cap were revoked. We conclude that the annual savings targets could reasonably scale up to 2% for the program year beginning June 1, 2015, and stay at 2% annually for three years, until the end of the 5-year period on May 31, 2018. This level of savings would require annual efficiency spending of nearly $540 million, as opposed to the current cap of roughly $245 million, but would significantly increase the net benefits of efficiency to Pennsylvania's ratepayers and to society at large. Figure 1 below shows expected savings under both the budget-constrained and unconstrained scenarios. Either scenario would more than offset Pennsylvania's expected load growth over the five years.

**Figure 1: Electric Savings by Scenario**




Finally, while Act 129 is a remarkable step for energy efficiency in Pennsylvania, we believe that a few policy changes could fully unlock efficiency's potential in the state. The report's final section examines current Pennsylvania efficiency policy, looks at ways to better align utility and ratepayer incentives, and suggests changes to the TRC test in line with industry standards and best practices.

# BENEFITS OF EFFICIENCY

## ENERGY AND CAPACITY BENEFITS

Capacity, energy, and transmission and distribution (T&D) benefits are the main quantified benefits in the typical cost-effectiveness tests for demand-side management (DSM) programs. Capacity costs avoided are primarily related to the ability to delay or reduce the size of new generation facilities, as load-serving entities do not have acquire as much capacity in order to ensure adequate peak demand generation. Capacity avoided costs may take the form of direct revenue from demand reduction that is bid into the PJM Reliability Pricing Model (RPM). Energy costs are avoided primarily through lower fuel and operating expenses associated with generating and delivering less electricity – these are typically the most significant component of the avoided costs. Finally, local T&D projects may also be reduced or delayed due to efficiency, and are thus included as a component in the total avoided costs of efficiency.

## NON-RESOURCE BENEFITS

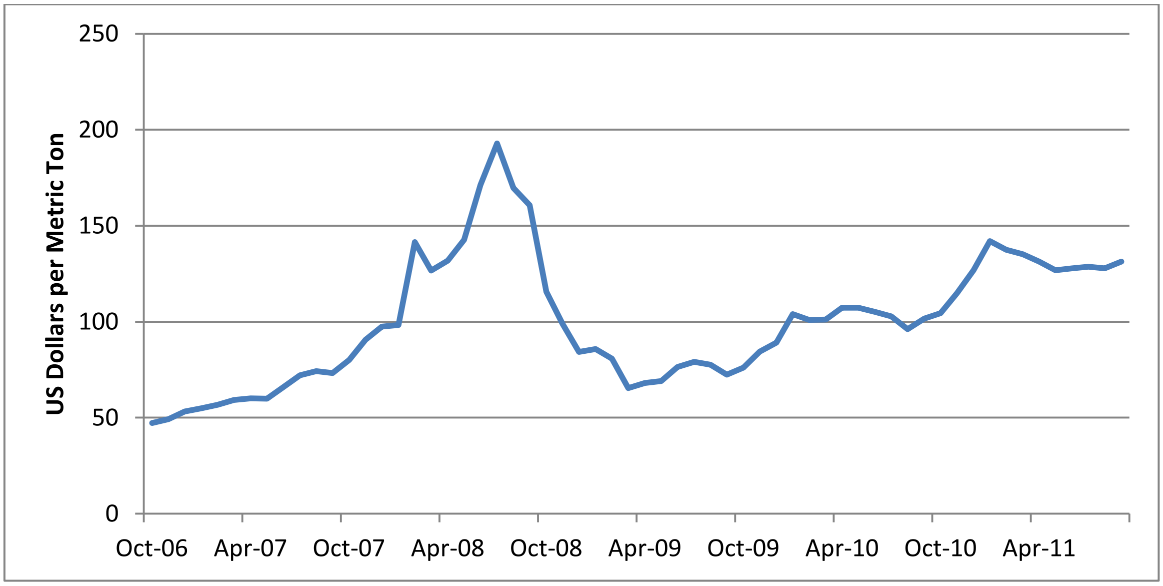
Many energy efficiency measures create direct, quantifiable benefits that are not related to electricity. These primarily consist of reduction of water, fuel, and operation and maintenance (O&M) costs. Insulation, for example, reduces heating fuel costs in the winter in addition to electricity costs in the summer. Efficient dishwashers typically use around half the water as the standard model. LED lighting projects have significant O&M savings from the reduced need to replace the lamps – especially for hard-to-reach applications such as warehouses and parking lots. In best practices, these non-resource benefits are included as benefits in the total resource cost test (TRC). In practice, the vast majority of states do allow the inclusion of these benefits in the TRC. Pennsylvania currently allows O&M benefits, but not fossil fuel benefits.

## RISK REDUCTION

Since the largest portion of the marginal costs of producing electricity are related to fuel expenses, and since coal is the most significant source of electricity in the state, electric prices are highly correlated to the price of coal. The chart below shows that coal prices spiked in 2008, and have been rising again since then.[3] More generally, commodity prices have become more volatile in recent years, a trend which is likely to continue in the face of increased demand from countries such as China and India and the uncertain global economic outlook. By reducing the amount of coal required to meet Pennsylvania's electricity needs, efficiency will mitigate the risk of large swings in coal price for the electric ratepayers.

[3] http://www.indexmundi.com/commodities/?commodity=coal-australian&months=60

**Figure 2: Coal Prices 2006-2011**




Another type of risk relates to the construction of new generation facilities. Since these facilities may take 10 years or longer to get up and running, while demand side investments start saving energy right away, generation facilities are far more exposed to unexpected capital cost overruns, such as from rising labor and/or material costs. Some states have begun to quantify the value of reduced risk from efficiency and include it as a benefit in the TRC test. Vermont, for example, adds 10% to the benefits of avoided energy and capacity as a proxy for this risk reduction. However, this practice is still fairly rare.

## DEMAND REDUCTION INDUCED PRICE EFFECTS

Many states, especially in New England, are beginning to recognize Demand Reduction Induced Price Effects (DRIPE) as a quantifiable benefit of energy efficiency and demand response. DRIPE is a measurement of the value of efficiency in terms of the reduction of wholesale energy prices seen by all retail customers. The reduced energy demand due to efficiency programs allows for the shedding of the most expensive resources on the margin and lowering the overall costs of energy. This reduces the wholesale prices of energy and demand, and this reduction, in a relatively deregulated market, is in theory passed on to retail customers. The effects on energy prices are small in terms of percentage reductions; however, the absolute dollar impacts are significant as the percent price reduction is applied across the entire body of all Pennsylvania energy consumers.

Originally, it was thought that DRIPE would only be significant in the short-term. In the long run, market actors would react to lower energy consumption and peak demand by retiring inefficient generators. With lower available supply, wholesale prices would begin to increase again, assuming no other changes in demand. However, the most recent study on avoided costs in New England concluded that DRIPE impacts persist far longer than had been assumed. DRIPE effects in New England are now estimated to last 11 years for peak capacity reductions, and 13 years for energy reductions. The per kWh values of DRIPE vary based on energy period and region, but for New England range from $0.001/kWh to $0.032/kWh for energy depending on energy period and region, and from $2.23/kW to $59.07/kW for peak demand, depending on region.

## ECONOMIC BENEFITS

There is a large and growing body of evidence that money spent on energy efficiency creates more jobs and provides a far greater stimulus to local economies than equivalent money spent on supply-side resources. Efficiency investments are far more labor intensive than supply-side resources, and require significant effort from contractors, design professionals, and suppliers/distributors. Academic research and interviews with small business owners from process evaluations both confirm that utility-run efficiency can be an enormous boon for small businesses. In fact, according to 2009 study done by the University of Massachusetts, Amherst, a $1 million investment in supply-side resources will create 5.3 jobs, while an equivalent investment in efficiency can be expected to create 16.7 jobs[4]. Table 1[5] below shows estimates of the jobs effect of efficiency spending. The multipliers are based on modeling by ACEEE, with multipliers adapted from IMPLAN. Typically, studies have found that around 10-20 net jobs are created per million dollars spent on efficiency.

**Table 1: Effect of Efficiency Spending on Jobs[6]**

| Spending Category | Impact | Amount (Millions) | Job Multiplier | Job Impact (job-years) |
|---|---|---|---|---|
| Installation | Upfront payment for efficiency measures | $100 | 13 | 1,300 |
| Consumer Spending | Because of efficiency spending, consumers spend less in the short term | -$100 | 12 | -1,200 |
| Consumer Savings | Because of energy savings, consumers spend more in the long term | $200 | 12 | 2,400 |
| Lost Utility Revenues | Utility revenues decrease because of energy savings | -$200 | 5 | -1,000 |
| **Net effect of a $100 million investment in efficiency measures** | | | | **1,500** |

In addition to direct job benefits, one dollar of efficiency spending creates more than one dollar of economic activity. In economics, this is known as the multiplier-effect. While every economic activity has some multiplier, the multiplier for efficiency spending is larger than that of many other activities, and is especially larger than the multiplier associated with supply-side spending. The efficiency multiplier occurs as 1) people who are employed due to the efficiency

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4 Throughout the report, one "job" represents one full time job for one year.

5 ACEEE. *Potential for Energy Efficiency, Demand Response, And Onsite Solar Energy in Pennsylvania. April, 2009.*

6 This study uses the same job multiplier as was found in the PA ACEEE study, or 15 jobs per million dollars spent. This number is actually on the low side of multipliers found in the economic literature. When this paper references jobs created, it is referring to a job as one full time job for one year.

program re-spend their new income into the economy; 2) increased demand for efficient products causes increased demand for upstream suppliers; and, 3) money saved by ratepayers from lower energy bills is spent on other things. A detailed 2009 study for the New England region found a multiplier of 9.64.[7] This means that, for every $1 spent on efficiency programs, an extra $9.64 of economic activity is created.

These estimates have been validated by economic studies of specific investment decisions. For example, a 2009 study in East Kentucky found that efficiency investment of $634.2 million would create $1.2 billion of local economic activity and create over 5,400 jobs, not including the effect of energy savings being reinvested into the local economy. A coal plant to produce the equivalent amount of energy would not only be more expensive, but would create only 700 jobs during the 3-year construction phase and 60 positions once operational.[8]

## HEALTH BENEFITS

Air pollution such as sulfur dioxide, nitrogen oxides, and particulate matter emitted during electricity generation causes health effects which do significant damage to both public well-being and the economy. Adverse effects include increased incidences of asthma, respiratory and cardiac diseases, higher mortality rates, and increased medical and hospitalization spending. In fact, there is reason to believe that increased health costs due to air emissions effectively double the price of coal-fired electricity. For example, a recent study from Harvard University finds that adverse health impacts from coal generation cost the public an average of 9.3 cents per kWh of power generated.[9,10] A study for the European Union estimates direct externalities at between 4 and 15 euro cents per kWh for coal generation, between 3 and 11 euro cents per kWh for oil, and between 1 and 3 cents per kWh for gas, consistent with the Harvard study.[11] Another study found that Ontario's electric generation produces 668 premature deaths, 928 extra hospital admissions, 1,100 extra emergency room visits, and 333,600 minor illnesses. The financial impact of these health effects is estimated to be over $3 billion per year. The study estimates total Ontario consumption at 26.6 TWh/year, implying health costs for Ontario of over $0.11 per kWh.

Although coal plants represent 48% of total in-state generation, the only other major generation source is nuclear power, which makes up 34% of generation and is a baseload source (natural gas, at 15%, makes up almost all the rest).[12] Therefore, any reduction in Pennsylvania electric consumption is overwhelmingly likely to offset coal-based generation, rather than gas, hydro, or renewable sources. This is confirmed in an ICF Consulting report, concluding that emission reductions per MWh of efficiency are about the same as emissions caused by one MWh of electricity from coal.[13],[14] As a result, the health benefits for each MWh saved are likely to

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[7] http://www.env-ne.org/public/resources/pdf/ENE_EnergyEfficiencyEngineofEconomicGrowth_FINAL.pdf

[8] http://www.ochscenter.org/documents/EKPC_report.pdf

[9] This is an average. The actual value varies widely from plant to plant based on its age, type of pollution controls, and downwind population.

[10] Epstein et al. Page 86. http://solar.gwu.edu/index_files/Resources_files/epstein_full%20cost%20of%20coal.pdf

[11] Page 13. http://www.externe.info/externpr.pdf

[12] EPA. Electric Power Annual 2010. http://www.eia.gov/cneaf/electricity/epa/epa_sprdshts.html

[13] http://www.p2pays.org/ref/07/06861.pdf

approach the health costs of coal discussed in the previous paragraph, and so, if accounted for in the cost-effectiveness tests, would about double the monetary benefits of efficiency.

## ENVIRONMENTAL BENEFITS

According to the EIA, Pennsylvania has the second most emissions of $CO_2$, NOx, and $SO_2$ of any state in the nation, largely due to higher absolute electricity consumption relative to other states. In addition to the health effects discussed above, these emissions carry significant environmental costs. Although environmental damage can be very difficult to quantify, some include:

- Surface water and soil acidification
- Damage to vegetation and forests
- Contributions to coastal eutrophication, causing algal blooms, depletion of dissolved oxygen, changes in biodiversity, and losses in the tourism/fishing industry
- Faster weathering of buildings
- Reduced visibility from smog and haze
- Mercury accumulation in fish

Furthermore, $CO_2$ emissions contribute to global climate change, which has the potential to cause significant economic losses from agricultural and increased infrastructure expenses. Since Pennsylvania emits the second most $CO_2$ of any state in the nation, its efficiency efforts can make a significant difference to US climate change abatement efforts.

## OTHER BENEFITS

Efficient buildings tend to have less temperature swings, better lighting levels, less glare, lower temperature gradients, and better indoor air quality than standard buildings. These additional benefits partly improve participant comfort and quality of life, but may also manifest as decreased illnesses and increased worker productivity which can translate into additional economic benefits. The links between buildings and occupant health and productivity are very complex and difficult to generalize. However, the Center for Building Performance Diagnostics at Carnegie Mellon University has created a database of studies that have attempted to quantify this link. Overall, it finds that building environments that are associated with efficiency, such as increased outside air, individual control of lights, moisture control, and pollutant source controls reduce symptoms of illnesses such as flus, asthma, sick building syndrome, and headaches by an average of 43%. Other measures, such as window views, natural ventilation, and increased day-lighting reduce symptoms by an average of 36%. Further, the studies find that lighting measures in offices increase worker productivity by a median of 3.2%. These estimates are highly uncertain, and the past efforts to quantify the benefits have found a range of from less than $10

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[14] Finds emissions of 11.59 pounds of SO2 per MWh reduced, compared to 14 pounds of SO2 per MWh of coal generation. http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html

to $50 per square foot over 20 years. Since the energy savings over 20 years for a typical LEED-certified building are about $10 per square foot, even the low range of this estimate would mean that health and productivity benefits equal the energy saving benefits of green buildings.[15]

[15] Kats, Greg. *Greening Our Built World*.

# POTENTIAL ANALYSIS

## CURRENT PENNSYLVANIA EFFICIENCY PROGRAMS

Act 129 set goals for saving 3% of sales and 4.5% of peak demand by May 31, 2013, using a budget cap of 2% of 2006 utility revenues. This analysis looks at the economic potential for the June 1, 2013 – May 31, 2018 period, and suggests energy savings targets for the next 5-year period, and peak demand-reduction targets for the next 4-year period.

## ECONOMIC POTENTIAL

The economic potential is the energy reduction potential if all cost-effective measures were installed. It is typically a snapshot in time, although many studies create an estimate over a certain time period in order to account for new construction potential and technologies that are only cost-effective as a replacement for a burnt out measure.[16] The economic potential serves as an upper bound on efficiency efforts, and can give legislators, public utility commissions, and utilities confidence that they are not setting unachievable goals. However, it is also important to note that the economic potential consistently increases over time due to advances in technology, lower equipment costs, and/or rising energy prices. Indeed, the vast majority of economic potential studies find potential in the 20%-30% range, regardless of the region of study or the state's history with efficiency programs. For example, two separate studies in New York – one from 1984 and one from 2003 – found nearly identical economic efficiency potential despite fairly aggressive efficiency efforts in the intervening 19 years.

## ELECTRICITY FORECAST

This analysis uses 2018 as a target year for the economic potential in order enable an 'apples-to-apples' comparison of the economic potential to the cumulative 5-year June 1, 2013 – May 31, 2018 savings goals. We use 2018 because we want to compare the economic potential with the suggested cumulative savings for the 5-year period ending on May 31, 2018. To create the forecast, we use 2010-2015 projections from the Pennsylvania Public Utilities Commission (PUC) for energy use through 2015, and sector-specific long term growth rates from the EIA Annual Energy Outlook 2011 for consumption from 2016-2022. Since efficiency potential varies by sector, we looked separately at consumption in Pennsylvania's two biggest cities, Philadelphia and Pittsburgh, which together make up around 37% of the state's electricity use. Figure 3 shows the percent electricity consumption by sector for Philadelphia, Pittsburgh, and the rest of the state. The electric sales from PECO, which supplies 96% of Philadelphia's electricity, and Duquesne, which supplies 90% of Pittsburgh's electricity were used as proxies for the consumption of the two cities.

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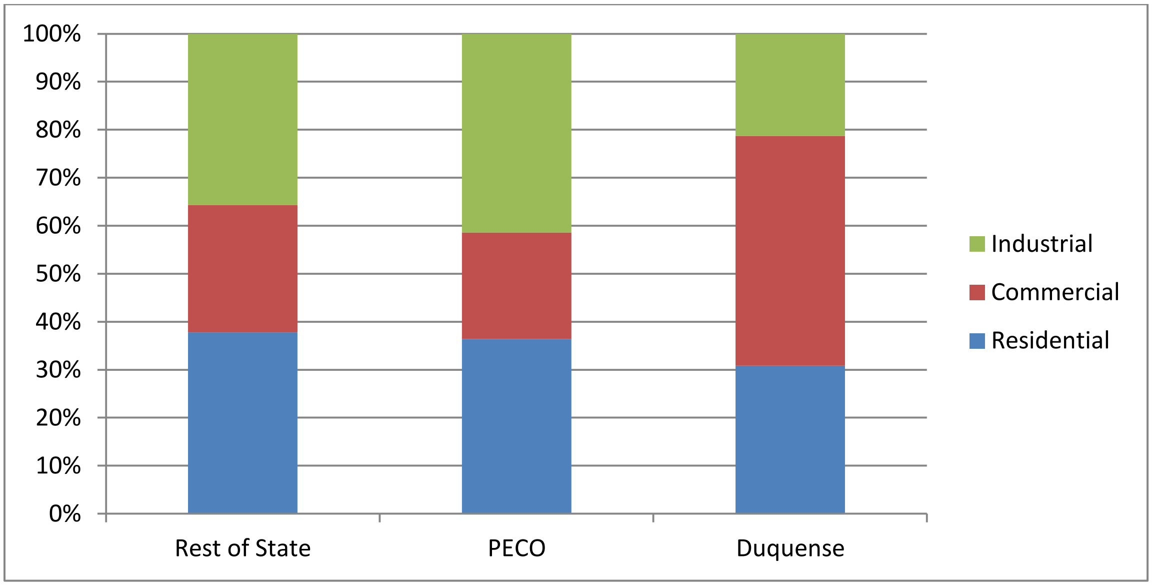
[16] Replace-on-burnout, or lost opportunity measures refer to when a piece of equipment is replaced with more efficient equipment, rather than the standard technology. This type of measure may be more cost-effective than retrofits because the cost is the difference in price between the two technologies, rather than the full installed cost for the efficient equipment.

**Figure 3: Distribution of Pennsylvania Energy Consumption by Sector**




Overall, industrial and residential buildings use just under 40% of total electricity, while commercial buildings make up just under 30% of total usage. The exception to this is in Pittsburgh, where commercial buildings make up almost 50% of total use.

Based on numbers reported to the PUC, Pennsylvania's total 2010 electricity consumption for the residential, commercial and industrial sectors was 142,991 GWh. This number does not include sales to the transportation sector, other states in PJM territory, or line losses (~6.2% of total consumption). Figure 4 below shows the forecast from 2010-2024 for total electricity consumption. The forecast uses the growth rates from the PUC forecast from 2010 – 2015, and forecasts for the Middle Atlantic region from EIA's Energy outlook 2011 for the growth rate from 2016-2024. Figure 5 shows the expected growth in peak demand for the same period. The data for the peak demand is much more limited: there is no disaggregation by sector and the Annual Energy Outlook does not give estimates. Therefore demand is only shown at a statewide level, and relies on PUC estimates. In 2010, Pennsylvania had a peak demand of 29,515 MW.

**Figure 4: Energy Forecast from 2010-2018 (GWh)**

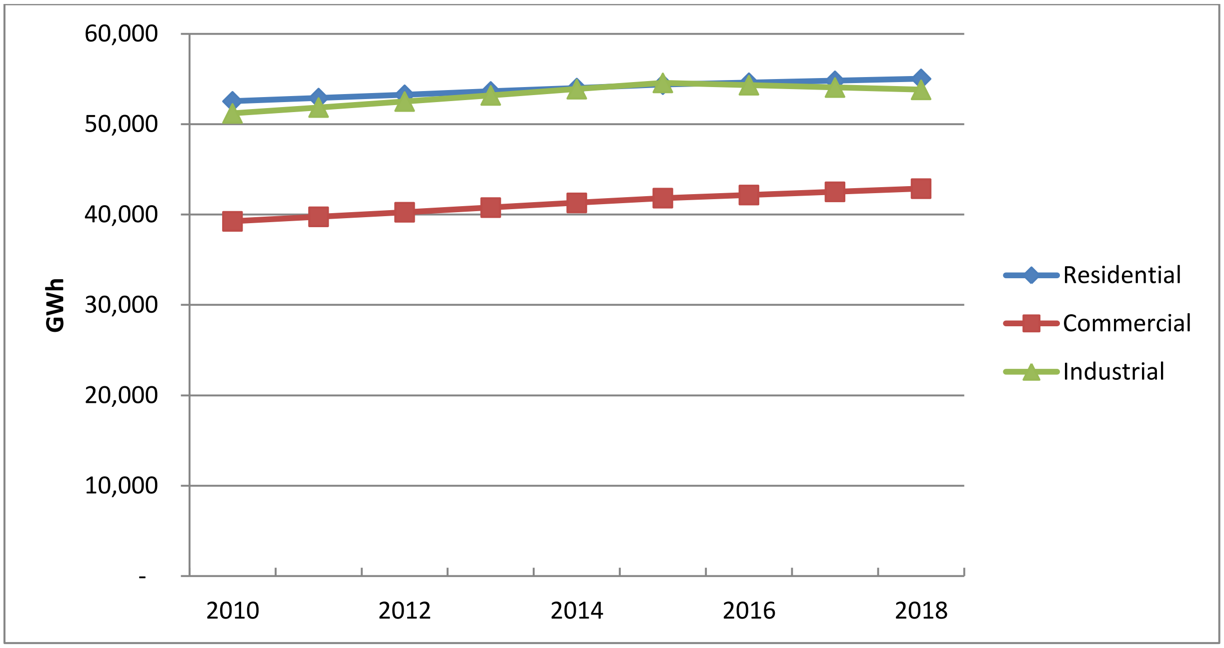
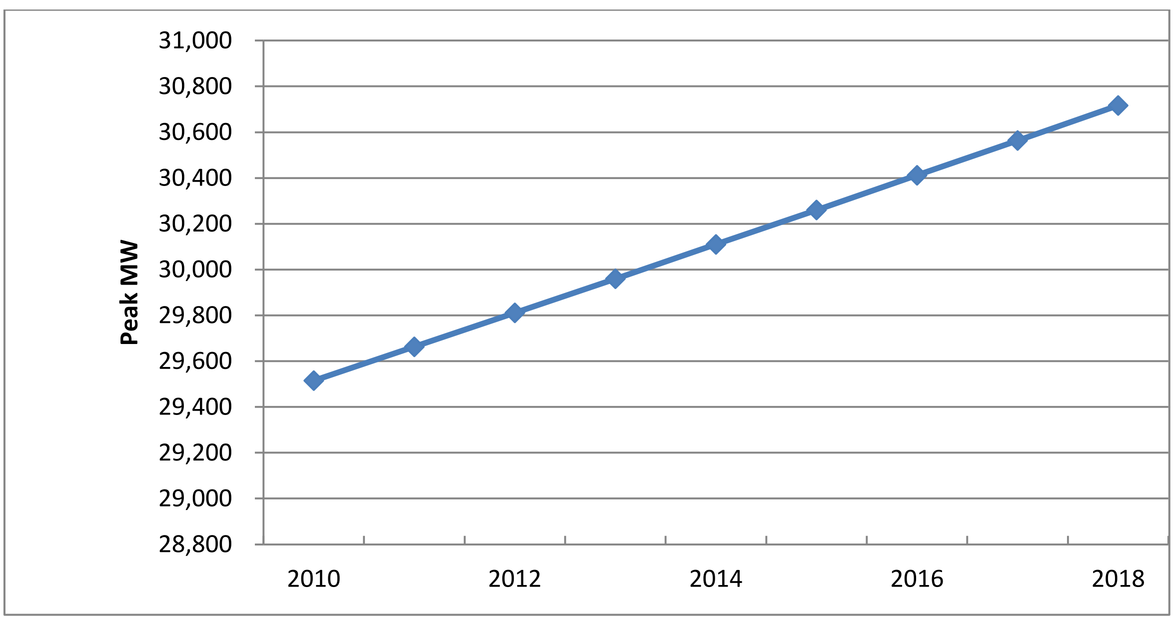



**Figure 5: Peak Demand Forecast from 2010-2018 (MW)**




The forecast above assumes the Electric Distribution Companies (EDCs) meet their 2013 goals, but that no further efficiency efforts are extended. This analysis will use 2018 as the target year, since it examines the efficiency goals for the 2013-2018 time period. Table 2 below shows Pennsylvania's expected electricity consumption for 2018. The peak demand in 2018 is expected to reach 30,716 MW.

**Table 2: Energy Consumption in 2018 (GWh)**

| | Philadelphia | Pittsburgh | Rest of State | Total |
|---|---|---|---|---|
| Residential | 15,072 | 4,533 | 35,415 | 55,020 |
| Commercial | 9,448 | 7,232 | 26,195 | 42,875 |
| Industrial | 16,889 | 2,689 | 34,230 | 53,809 |
| **Total** | **41,410** | **14,454** | **95,840** | **151,704** |

## Energy Reduction

In order to develop an estimate for the total economic potential in Pennsylvania, we reviewed several recent potential studies. These studies typically develop separate potential estimates for the residential, commercial, and industrial sectors. As Table 3 shows, the economic potential is fairly consistent across studies and regions, despite differences in baseline technologies, local weather conditions, and study methodologies. The median value for potential across the studies is 26% of the residential sector, 28% of the commercial sector and 16% of the industrial sector. Specific results can be seen in Table 3 below.

**Table 3: Economic Potential by State[17]**

| | Residential | | Commercial | | Industrial | |
|---|---|---|---|---|---|---|
| | GWh | MW | GWh | MW | GWh | MW |
| Pennsylvania (2009)* | 30% | 35% | 29% | 35% | 16% | 35% |
| Virginia (2008) | 26% | 25% | 28% | 25% | 25% | 25% |
| RI Opportunity Report (2008) | 28% | 30% | 28% | 35% | 14% | 25% |
| New Jersey (2004) | 19% | N/A | 19 % | N/A | 7.92% | N/A |
| Georgia (2005) | 21% | 20% | 22% | 18% | 15% | 15% |
| North Carolina (2006) | 20% | N/A | 22% | N/A | 17.50% | N/A |
| Texas(2007)* | 32% | 12.5%** | 39% | 12.50% | 26% | 12.50% |
| Connecticut (2009) | 32% | N/A | 42% | N/A | 33% | N/A |
| Kansas (2008) | 35% | 38% | 34% | 38% | N/A | N/A |
| **MEDIAN** | **26%** | **28%** | **28%** | **25%** | **16%** | **25%** |

* Didn't break out peak demand by Sector, assumed to be equal across sectors

**Demand response only

This analysis assumes the economic potential for Pennsylvania is equal to the median savings of the studies above. Note that this value is actually very close to the numbers found in the Pennsylvania-specific study done by ACEEE in 2009, and represents significant savings.

17 See Appendix for references

## Peak Demand Reduction

Unfortunately, there have not been many studies that fully explore the potential peak demand reduction from both efficiency and demand response efforts. However, ACEEE completed a comprehensive investigation on this topic for Pennsylvania in 2009 and found a total possible demand reduction of 35% compared to the forecast: 23% from energy efficiency and 12% from demand response. This is in line with other studies. It is slightly lower than what was found in Georgia; the 12% from demand response matches very well with what has been found in Texas and other states. For these reasons, this analysis assumes the economic demand reduction is equal to what was found in the ACEEE study, or a 35% reduction over the forecast.

## Savings by End Use

There is a high degree of variance in the distribution of efficiency potential by end use found in the studies surveyed, despite the high degree of consistency in the overall potential. For example, lighting measures make up anywhere between 16% and 70% of the total residential potential, depending on the study. This is in part due to the lack of consistency in end-use categories across studies, and in part to different measure mixes, baseline assumptions, and technology penetrations. We accounted for this as best as possible by combining end-use potentials into common categories based on the specific measures addressed in each study Figures 6 and 7 below show the distribution of savings for the residential and commercial sectors, based on the average values of the studies surveyed.

**Figure 6: Residential Energy Savings by End-Use**

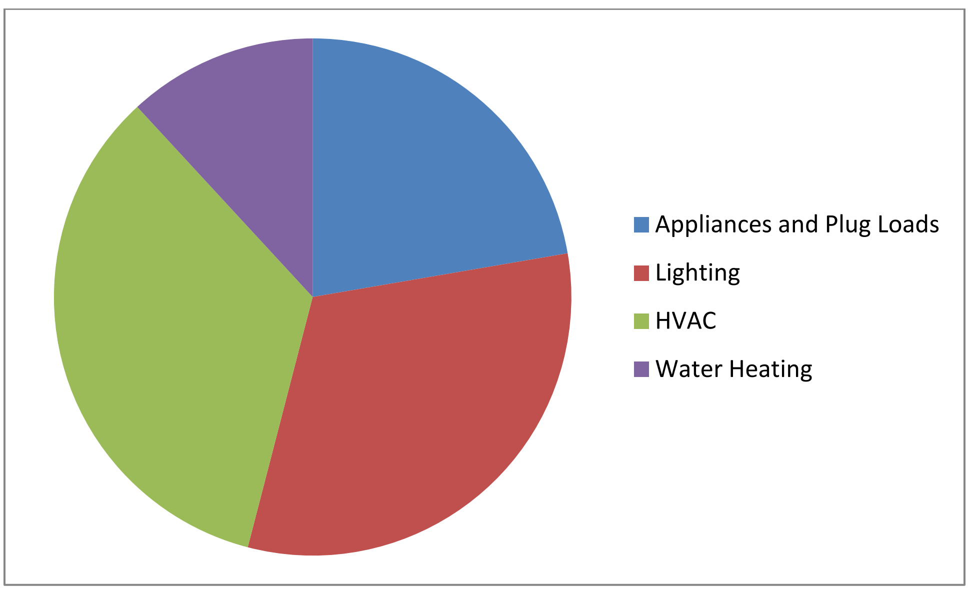
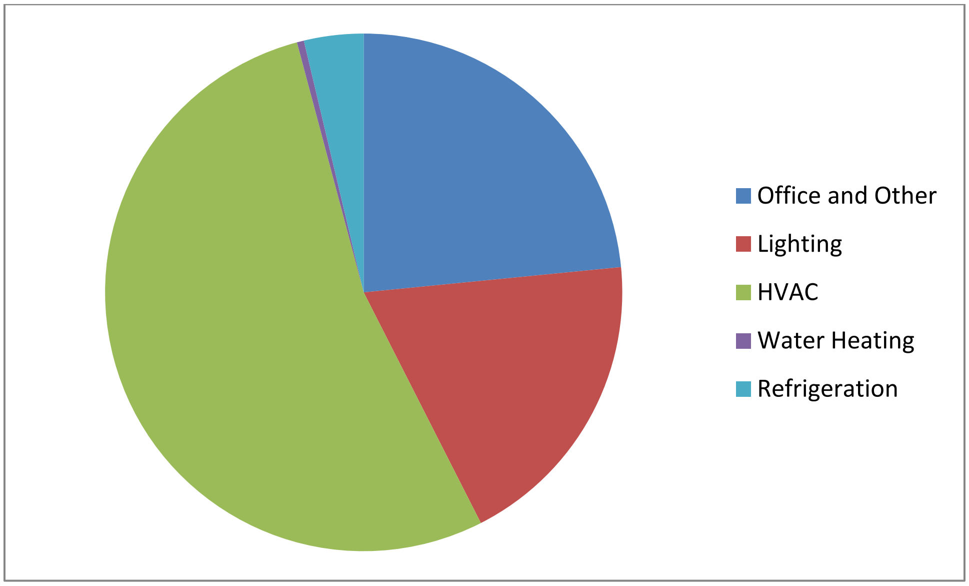


**Figure 7: Commercial Energy Savings by End-Use**




## Total Results

In all, there is a total economic potential of 31,514 GWh of energy savings in 2018 and a total potential peak reduction of 10,751 MW. Table 4 gives the details by sector and end-use.

**Table 4: Total Energy Savings and Peak Demand Reduction**

| Sector | End Use | Energy Savings (GWh) |
|---|---|---|
| **Residential** | Appliances and Plug Loads | 2,821 |
| | Lighting | 4,016 |
| | HVAC | 4,314 |
| | Water Heating | 1,501 |
| | **Res Total** | **12,652** |
| **Commercial** | Office and Other | 2,403 |
| | Lighting | 1,955 |
| | HVAC | 5,467 |
| | Water Heating | 44 |
| | Refrigeration | 381 |
| | **Commercial Total** | **10,253** |
| **Industrial** | | **8,609** |
| **Total** | | **31,514** |

## ACHIEVABLE POTENTIAL AND SAVINGS GOALS

### Cost of Efficiency

In order to find the cost of efficiency in Pennsylvania, we reviewed actual costs per annual kWh saved in several states with current efficiency programs. Cost per annual kWh saved is a straightforward and standard metric that is calculated by taking the ratio of the total program cost to the annual energy savings generated by all of the measures installed as a result of those expenditures. Because savings can be expected last the length of the life of the average measure, typically in the range of 10-15 years, the cost per annual kWh saved is not comparable to either retail electric rates or the levelized cost of energy from a traditional supply-side resource.

To investigate typical costs, we draw from three primary sources: a 2009 ACEEE study on levelized costs, an extensive study done by Summit Blue (now Navigant) looking at costs and savings from 2006 efficiency programs, and a concurrent review of annual reports for program years 2007-2010. Table 5 shows the median and average results, by sector. For comparison purposes, the Pennsylvania results from the first two program years are included in the table.

**Table 5: Cost per annual kWh by Sector**

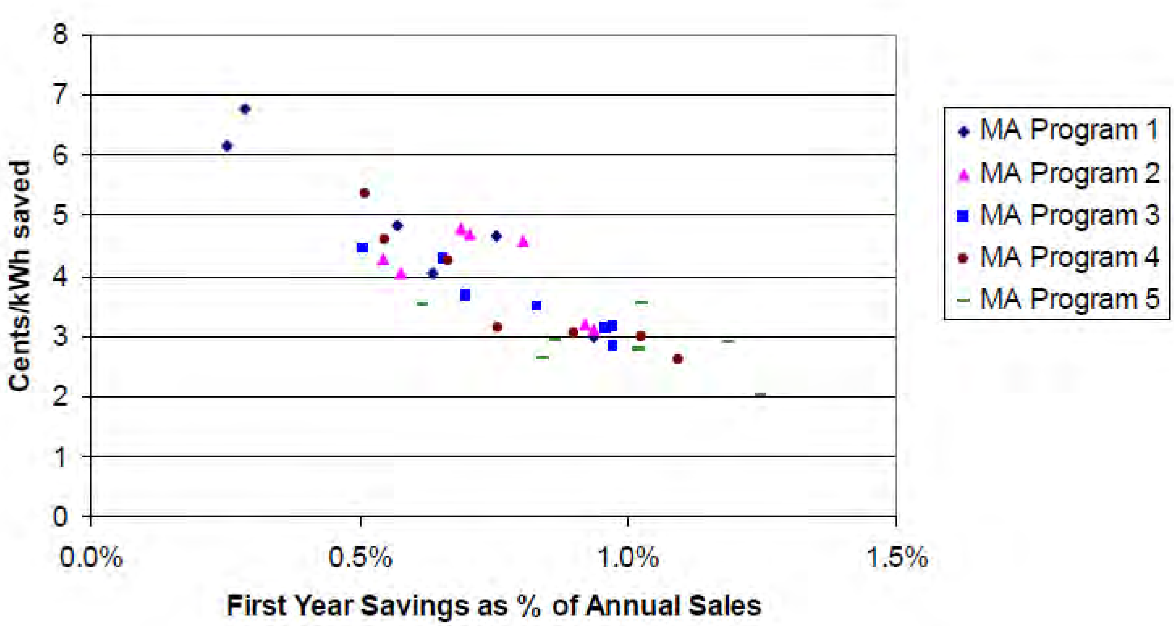
| | $/annual kWh | | | $/kW | | |
|---|---|---|---|---|---|---|
| | Residential | C&I | Total | Residential | C&I | Total |
| Summit Blue Median | $0.27 | $0.14 | $0.18 | $915 | $680 | $836 |
| Summit Blue Weighted Average | $0.23 | $0.17 | $0.20 | $976 | $903 | $946 |
| Annual Reports Sample Median | $0.43 | $0.21 | N/A | $2,651 | $1,395 | N/A |
| Annual Reports Weighted Average | $0.24 | $0.22 | $0.23 | $938 | $780 | $825 |
| ACEEE Median | N/A | N/A | $0.25 | N/A | N/A | N/A |
| **PA PY 1 and PY 2 Total** | | | **$0.14*** | | | **$880** |
| **Mean Weighted Average (Not including PA)** | **$0.24** | **$0.20** | **$0.21** | **$957** | **$842** | **$886** |

*PA costs look low in part because PECO's costs ($0.09/kWh) are low due to large savings from a low cost voltage reduction program. With PECO excluded, PA costs rise to $0.17/kWh and range from $0.12/kWh to $0.22/kWh

As seen in the table, there is sometimes a very large difference between the median value and the weighted average value, especially for the residential results from the annual reports. This is likely due to the inclusion of numerous small pilot programs that make the median cost seem very expensive, but that don't contribute significantly to either the efficiency budget or the savings. This is supported by the fact that the weighted average is very consistent across all three sources. Therefore, going forwards, this analysis will use the mean weighted average savings between the Summit Blue Study and the Annual Report review.

As efficiency programs scale, there are two different effects on the cost of efficiency. First, programs may have to promote more expensive measures in order to meet the more aggressive efficiency goals. On the other hand, economies of scale allow efficiency programs to be run more efficiently, disbursing more incentive money for the same administration and implementation expenses. Further, larger programs often result in increased awareness of energy efficiency, which may allow utilities to achieve penetrations with lower incentive amounts. For the purpose of this analysis, it is assumed that these two effects will cancel each other out, and the cost of efficiency by end use will be the same regardless of savings goals. However, there is some evidence that more aggressive programs tend to acquire cheaper savings, at least for the savings goals currently in existence. For example, Figure 8 clearly shows that as Massachusetts programs developed and expanded, the cost per unit savings lowered.

**Figure 8: MA Cost as a Function of Savings[18]**




## Budget Constrained Scenario

As described above, Act 129 requires Pennsylvania utilities to reach cumulative savings of 3% of load, and a 4.5% reduction of peak demand by May 31, 2013. Further, this must be accomplished while spending no more than 2% of the utilities' 2006 revenue per year. Table 6 shows the savings goals, spending caps, and the cost per kWh needed to achieve the goals within the spending caps.

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[18] See, for example: http://www.synapse-energy.com/Downloads/SynapseReport.2008-08.0.MA-Electric-Utility-Energy-Efficiency.08-075.pdf

**Table 6: 2009-2013 Act 129 Spending Caps and Savings Goals**

| | 4- year Revenue Caps ($ Million) | 4-year goal (GWH) | 4-year goal (MW) | $/kWh | $/kW |
|---|---|---|---|---|---|
| Duquesne | $78 | 423 | 113 | $0.18 | $690 |
| Met-Ed | $99 | 446 | 119 | $0.22 | $832 |
| Penelec | $92 | 432 | 108 | $0.21 | $852 |
| Penn Power | $27 | 143 | 144 | $0.19 | $605 |
| PPL | $246 | 1,146 | 297 | $0.21 | $828 |
| PECO | $342 | 1,182 | 355 | $0.29 | $963 |
| West Penn | $94 | 628 | 157 | $0.15 | $598 |
| **Total** | **$978** | **$4,399** | **$1,293** | **$0.22** | **$756** |

As seen, the statewide $/kWh needed to meet the goals within the budget cap is just about equal to the nationwide average, while the $/kW is slightly lower. This table, however, includes a ramp up in savings – only 1% of savings are needed in the first two years, while another 2% savings are needed in the next two years. If we look at the incremental spending and savings needed to achieve the 2013 goals, the savings must be acquired at lower cost. This is because the savings targets ramp up in years 3 and 4, while the spending cap does not. If the next 5-year goal were set to 1% savings a year for a total of 5% savings, the overall cost per annual kWh saved has to be lower than for the first 4-year period. In particular, each year's goal and $/kWh would be as described in Table 7:

**Table 7: 2013 Incremental Spending and Savings**

| | 2013 Energy Savings (GWh) | $/kWh |
|---|---|---|
| Duquesne | 141 | $0.14 |
| Met-Ed | 149 | $0.17 |
| Penelec | 144 | $0.16 |
| Penn Power | 48 | $0.14 |
| PPL | 382 | $0.16 |
| PECO | 394 | $0.22 |
| West Penn | 209 | $0.11 |
| **Total** | **1,466** | **$0.17** |

In the final two years of the four year plan, the utilities will have to save energy at $0.17/kWh, well below both the $0.21/kWh weighted average found in the analysis above, and the $0.25/kWh average found in the ACEEE study. This level of savings is certainly feasible - utilities such as Southern California Edison are achieving more that 1% of sales at a cost of less than $0.18/kWh. Further, for the first two years of Act 129 implementation, Pennsylvania utilities spent just $0.13/kWh. However, we believe that this cost of $0.17/kWh is at the lower limit of what utilities should be required to reach. Lower costs would likely require cream-skimming –

programs that go after exclusively cheap, easy-to-reach measures while ignoring the more comprehensive opportunities for deeper savings and market transformation. We therefore recommend leaving annual savings goals at the same average annual levels as they were for the 2009-2013 plan, for the total annual GWh reductions shown above in Table 7. Cumulatively, over 5 years this would mean a reduction of 7,330 GWh, or 5% of 2011-2012 sales. Table 8 shows the suggested cumulative goals for year 2 and year 5 for the June 1, 2013 – May 31, 2018 efficiency efforts, along with the percent of the June 2013 – May 2014 sales this represents.[19] The annual energy goals have not changed from the current 2009-2013 plan. Note also that the savings below are at the site of the efficiency measure. Total system wide savings will be about 6% higher due to avoided transmission and distribution losses.

**Table 8: 2- and 5- Year Cumulative Energy Goals for Constrained Scenario**

| | 2011-2012 Sales (GWh) | 2015 (GWh) | % 2011-12 Sales | 2018 (GWh) | % of 2011-2012 Sales |
|---|---|---|---|---|---|
| Duquesne | 14,115 | 282 | 2.0% | 704 | 5.0% |
| Met-Ed | 14,138 | 297 | 2.1% | 743 | 5.3% |
| Penelec | 14,310 | 288 | 2.0% | 720 | 5.1% |
| Penn Power | 4,576 | 95 | 2.1% | 239 | 5.3% |
| PPL | 37,540 | 764 | 2.0% | 1,910 | 5.2% |
| PECO | 39,385 | 788 | 2.0% | 1,969 | 5.2% |
| West Penn | 20,379 | 419 | 2.1% | 1,047 | 5.2% |
| **Total** | **144,442** | **2,933** | **2.0%** | **7,332** | **5.2%** |

This report does not attempt to set peak demand goals for the next four-year period for the constrained scenario. However, based on experience from other states, achieving the energy targets above would naturally result in the following reductions in peak demand. Note that due to language in the Act 129 legislation, the demand reduction is shown for a four year period as opposed to a five year period.

[19] Sales forecast shown is for the residential, commercial, and industrial sectors for each utility. It does not include other sales, sales for resale, system losses, or company use. Adding these in would drop the goals as a percent of sales in 2018 to slightly under 5%. However, the gross energy (in GWh) represented by these goals would remain unaffected.

**Table 9: 2- and 4- Year Cumulative Demand Goals for Constrained Scenario**

| | 2011-2012 Peak Load (MW) | 2014-2015 (MW) | % of 2011-12 Peak | 2016-2017 (MW) | % of 2011-12 Peak |
|---|---|---|---|---|---|
| Duquesne | 2,982 | 44 | 1.5% | 88 | 3.0% |
| Met-Ed | 2,808 | 56 | 2.0% | 112 | 4.0% |
| Penelec | 2,660 | 52 | 2.0% | 104 | 3.9% |
| Penn Power | 944 | 15 | 1.6% | 30 | 3.2% |
| PPL | 7,439 | 139 | 1.9% | 278 | 3.7% |
| PECO | 8,917 | 193 | 2.2% | 386 | 4.3% |
| West Penn | 3,876 | 53 | 1.4% | 106 | 2.7% |
| **Total** | **29,627** | **552** | **1.9%** | **1,105** | **3.7%** |

## Unconstrained Scenario

As explained above, we believe that there are significant economic and environmental benefits to efficiency, and that the budget cap represents an artificial limit on benefits that efficiency can bring to the Pennsylvania ratepayers. By leaving the rate cap in place, the state is leaving a potential additional 15% savings on the table, which could be procured at well below the cost of new supply-side resources. Leading states such as Vermont, Massachusetts, and Rhode Island are now achieving over 2% savings per year or have submitted multi-year plans with greater than 2% annual savings. Therefore, as an aggressive yet achievable goal, we recommend further ramping up Pennsylvania's efficiency programs to achieve a cumulative savings of 2.75% after the first two years, and another 6% after the next three years, for a total of 8.75% savings. This allows a ramp-up in program savings during the first two years, in order to achieve 2% annual savings for the next 3-years, in line with leading states. We also suggest allowing the cost per kWh to come up to the nationwide median to allow pursuit of deeper savings and more comprehensive measures. This would mean an increase from an annual budget cap of $244.6 million to an annual budget of $538 million. Further, a decrease in peak demand of 2,345 MW, or 7.9% of total load can be expected over four years. Tables 10 and 11 show what this would look like for each utility. As in the constrained scenario, actual savings will be about 6.2% higher due to avoided Transmission and Distribution losses.

**Table 10: Energy Savings for 2015 and 2018 (GWh)**

| | 2015 Savings (GWh) | | | | | 2018 Savings (GWh) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Res | Com | Ind | Total | % of 2011-2012 Sales | Res | Com | Ind | Total | % of 2011-2012 Sales |
| Duquesne | 121 | 188 | 79 | 392 | 2.75% | 384 | 599 | 252 | 1,235 | 8.75% |
| Met-Ed | 156 | 84 | 149 | 396 | 2.75% | 495 | 268 | 474 | 1,237 | 8.75% |
| Penelec | 128 | 101 | 164 | 404 | 2.75% | 407 | 322 | 522 | 1,252 | 8.75% |
| Penn Power | 47 | 36 | 44 | 129 | 2.75% | 148 | 114 | 139 | 400 | 8.75% |
| PPL | 392 | 302 | 338 | 1,059 | 2.75% | 1,248 | 962 | 1,075 | 3,285 | 8.75% |
| PECO | 393 | 241 | 449 | 1,134 | 2.75% | 1,250 | 767 | 1,429 | 3,446 | 8.75% |
| West Penn | 204 | 140 | 217 | 577 | 2.75% | 648 | 445 | 691 | 1,783 | 8.75% |
| **Total** | **1,439** | **1,093** | **1,440** | **4,091** | **2.75%** | **4,580** | **3,477** | **4,582** | **12,639** | **8.75%** |

**Table 11: 2013-2018 Budget ($ Million)**

| | June 2013 – May 2015 Cumulative Budget | | | | June 2013 - May 2018 Cumulative Budget | | | |
|---|---|---|---|---|---|---|---|---|
| | Res | Com | Ind | Total | Res | Com | Ind | Total |
| Duquesne | $29 | $37 | $16 | $82 | $91 | $119 | $50 | $260 |
| Met-Ed | $37 | $17 | $30 | $83 | $118 | $53 | $94 | $265 |
| Penelec | $30 | $20 | $33 | $83 | $97 | $64 | $104 | $265 |
| Penn Power | $11 | $7 | $9 | $27 | $35 | $23 | $28 | $85 |
| PPL | $93 | $60 | $67 | $220 | $297 | $191 | $214 | $701 |
| PECO | $93 | $48 | $89 | $231 | $297 | $152 | $284 | $734 |
| West Penn | $48 | $28 | $43 | $119 | $154 | $88 | $137 | $380 |
| **Total** | **$342** | **$217** | **$286** | **$845** | **$1,088** | **$691** | **$911** | **$2,690** |

Table 12 shows the 4-year peak demand reduction goals. These goals are for four years rather than five years due to language in the legislation. However, the goals are assumed to be met using the same pot of money as the energy goals; most efficiency measures generate both energy savings and peak demand savings. In year 5, continued energy efficiency activities would create additional peak demand reductions that are not captured in the table below.

**Table 12: Peak Demand Reduction for 2015 and 2017**

| | 2015 Load Reduction (MW) | | | 2017 Load Reduction (MW) | | |
|---|---|---|---|---|---|---|
| | Res | C&I | % of 2011-2012 peak load | Res | C&I | % of 2010 peak load |
| Duquesne | 30 | 63 | 3.1% | 74 | 155 | 7.7% |
| Met-Ed | 39 | 55 | 3.3% | 95 | 135 | 8.2% |
| Penelec | 32 | 63 | 3.6% | 78 | 154 | 8.7% |
| Penn Power | 12 | 19 | 3.2% | 28 | 46 | 7.9% |
| PPL | 97 | 151 | 3.3% | 239 | 371 | 8.2% |
| PECO | 98 | 163 | 2.9% | 239 | 400 | 7.2% |
| West Penn | 51 | 84 | 3.5% | 124 | 207 | 8.5% |
| **Total** | **357** | **598** | **3.2%** | **877** | **1,468** | **7.9%** |

## Scenario Comparison

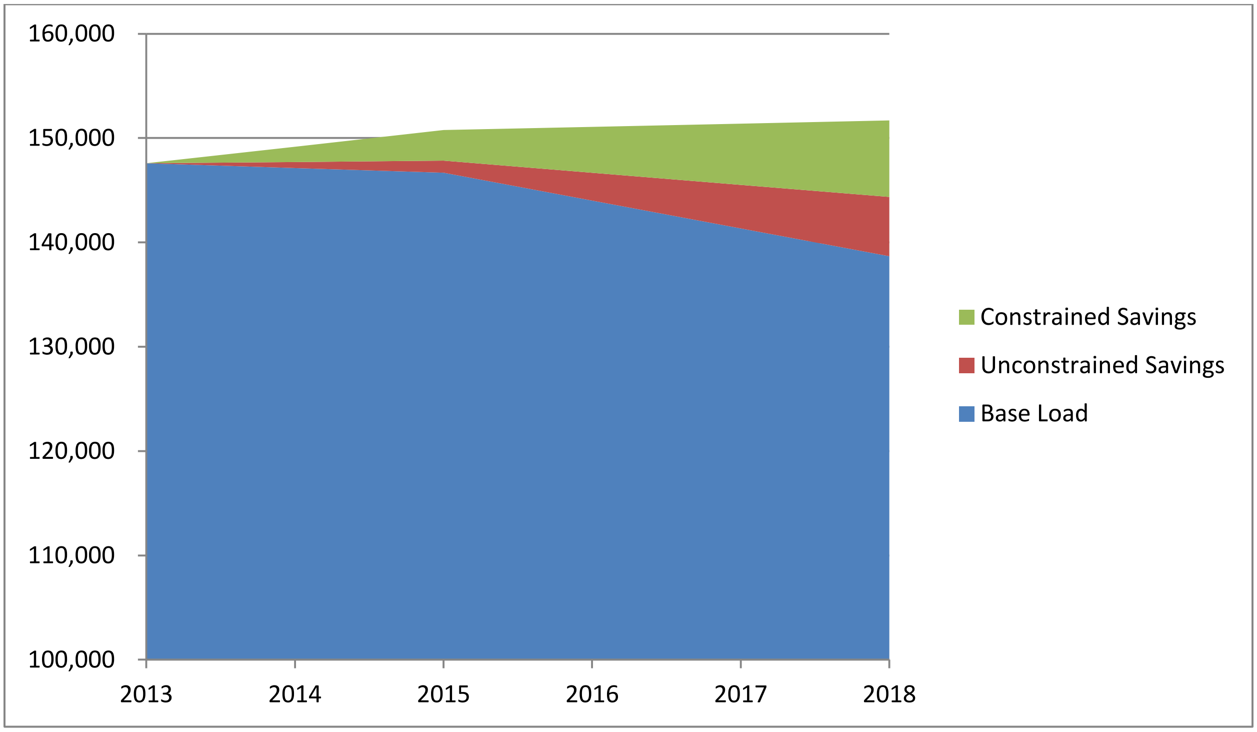
Tables 13 show a comparison between the economic potential and the savings achieved and the amount saved in the unconstrained scenario. As seen, even the unconstrained scenario is well below the economically feasible efficiency potential. This should provide confidence that any ramp up in program savings would comfortably be achieved cost-effectively.

**Table 13: Economic and Achievable Energy Potential in 2015 and 2018 (GWh)**

| | Savings in 2015 | | | Savings in 2018 | | |
|---|---|---|---|---|---|---|
| | Economic | Unconstrained | Constrained | Economic | Unconstrained | Constrained |
| **Energy Reduction (GWh)** | **N/A** | **3,972** | **2,933** | **31,514** | **12,638** | **7,332** |

Figure 9 below shows the baseline forecast compared to the constrained and unconstrained scenarios.

**Figure 9: Electric Forecasts under the Constrained and Unconstrained Scenarios**




As seen, Pennsylvania's electric load is expected to grow fairly slowly overall in the near term. Even under the constrained scenario, the absolute energy load is likely to slightly decrease. Under the unconstrained scenario, this decrease becomes fairly significant. This level savings would have large economic and environmental benefits to the state. It would significantly decrease the needed investment in supply and transmission based resources, and, to the extent that Pennsylvania currently produces more electricity than its load, would increase the sales to other states in the PJM transmission region.

Both efficiency policies create significant reductions in greenhouse gases. These reductions will help mitigate the problem of global warming, improve local smog and air quality problems, and reduce the magnitude of any future compliance costs from any potential regulations designed to mitigate climate change. As detailed in the table below, the 5-year targets in the constrained scenario create total lifetime GHG emission reductions equivalent to taking 14 million cars of the road for a year, and the unconstrained scenario creates reductions equivalent to taking 25 million cars off the road for a year.[20] The table also looks at jobs created, assuming 15 jobs per million dollars spent on efficiency, on the low side of estimates and consistent with the ACEEE PA Potential Study (see "Benefits" section).

[20] Emission factors from EPA Egrid. Car Equivalents from EPA carbon equivalent calculator.

**Table 14: Emissions and Jobs Benefits**

| | Tons Carbon Dioxide | Tons Methane | Tons Nitrous Oxide | Tons $CO_{2e}$ | Vehicles (million) | Jobs-Created |
|---|---|---|---|---|---|---|
| Constrained | 79,684,959 | 1,587 | 1,058 | 80,034,491 | 14 | 14,675 |
| Unconstrained | 137,353,945 | 2,735 | 1,823 | 137,956,437 | 25 | 40,351 |

The chart below attempts to quantify some of these benefits for both the constrained and unconstrained scenarios. The chart shows the lifetime net benefits (after subtracting out program spending) that would occur as a result of 2013-2018 efficiency spending. We have chosen reasonable, conservative values; however, the chart is highly simplified and is for illustrative purposes only – a full analysis would involve a much more nuanced inspection. For example, we assume an average avoided cost of $0.09 per kWh – this ignores large fluctuations in avoided costs during different time periods and for capacity. For benefits that last multiple years, we have assumed a 7% discount rate and an average measure life of 13 years. As seen, economic benefits dwarf costs under all scenarios and conceivable error bars – even if the assumptions below are overestimating benefits by 50% or more, efficiency results in large net benefits to Pennsylvania's economy.

**Figure 10: Lifetime Net Benefits from Efficiency**

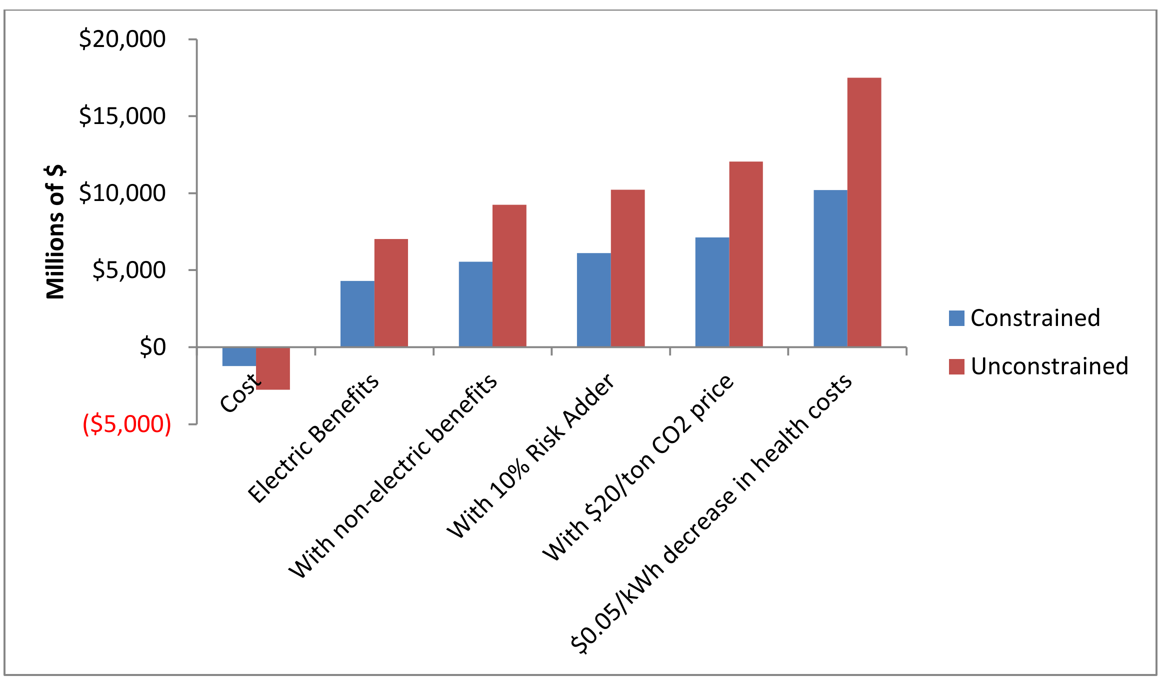


Table 15 shows the actual numbers from the figure. Like in the figure, all benefits shown are net benefits, and thus already take the costs into consideration.

**Table 15: Lifetime Net Benefits from Efficiency with Non-Electric Benefits ($ Millions)**

| | Cost | With Electric Benefits | With non-electric benefits | With 10% Risk Adder | With $20/ton CO2 price | With $0.05/kWh decrease in health costs |
|---|---|---|---|---|---|---|
| Constrained | ($1,223) | $4,292 | $5,549 | $6,100 | $7,129 | $10,193 |
| Unconstrained | ($2,768) | $7,024 | $9,254 | $10,234 | $12,061 | $17,500 |

# POLICY ANALYSIS

## COST-EFFECTIVENESS TEST

Like most states, Pennsylvania requires all programs to pass the total resource cost (TRC) test in order to be considered cost-effective. The total resource cost test compares the costs and benefits to society that are direct results of the efficiency program and is indifferent to transfers of money from one party to another. However, many details of how the TRC test is implemented vary from state to state. Appendix II shows details on how various states handle aspects of the TRC test. Currently, the Pennsylvania TRC test input parameters reflect:

- Savings in electricity based on avoided costs from the NYMEX PJM future price and EIA projections.
- No risk or environmental externalities in avoided costs
- Operation and Maintenance benefits may be included
- Fossil fuel and water benefits are not included
- Discount rate at the weighted average cost of capital for each utility.

While the Pennsylvania TRM test methodology for the most part comports with industry standards and the intent of the total resource cost, we recommend the following changes:

### Discount Rate

Pennsylvania uses the weighted average cost of utility capital (WACC) as the discount rate for the TRM test. Since the WACC does reflect the opportunity cost of capital by the utility, we believe that this discount rate is appropriate for utility-specific analyses such as those looking at rate impacts. However, it does not make sense to use the WACC for the TRC, which is meant to focus on benefits to Pennsylvania society without regard for distributional equity. The benefits of the total resource cost test represent benefits to society, and there is no particular reason why society as a whole should have the same time value of money of the utilities. In particular, we believe that a societal discount rate is most appropriate. In our experience, a real discount rate of 3-5% is fairly typical for TRC analysis, and we recommend that Pennsylvania lower its discount rate to within this range.

### Fossil Fuel and Water Benefits

Certain efficiency measures have provable and easily quantifiable fossil fuel and water savings in addition to their electricity savings. These savings are real, tangible benefits to society that occur as a direct result of the efficiency programs and should therefore be included in the total resource cost test. Pennsylvania, however, does not allow fossil fuel savings to be included in the TRC. Without these benefits, shell insulation measures, for example, will typically not screen. This leaves significant potential societal benefits on the table. Further, it is inconsistent to allow operation and maintenance savings to be included in the TRC test but not fossil fuel or water savings. In fact, Pennsylvania is one of very few jurisdictions that does not allow these benefits to be included in cost-effectiveness tests. This is true even for states and utilities that only run electric programs. The total resource cost test is designed to measure the costs and benefits to society, and fossil fuel savings represent a real, quantifiable societal benefit of many efficiency measures that are primarily designed to save electricity. We therefore recommend that Pennsylvania allow the benefits from fossil fuel and water savings to be included in the TRC test.

### Allowed Lifetime of Benefits

Pennsylvania does not allow any benefits to be included beyond 15 years from when the measure is installed. In other words, if the measure has an effective useful life (EUL) of 20 years, the last five years of benefits are not included in the TRC. In our opinion, this is an arbitrary cutoff, and, as far as we know, Pennsylvania is unique in imposing a limitation on the possible lifespan of societal benefits. There have been many extensive studies on the effective useful lives of various efficiency measures that have looked at factors such as early removal and early failure of the equipment, and have concluded that many measures can still be expected to last longer than 15 years. The discount rate will ensure that the benefits in years 15-20 will be worth less in present value terms than the benefits in earlier years; there is no reason to also impose a cutoff so that benefits suddenly drop to zero at year 15, especially when the measure can reasonably be expected to be in place for longer. We therefore recommend that the 15-year limit on benefits be removed and that the benefits be allowed to last for the expected life of the measure, as determined by the various industry studies.

### Demand Reduction Induced Price Effects (*DRIPE)*

As explained previously, many New England states are beginning to recognize demand reduction induced price effects (DRIPE) in their avoided costs. The Pennsylvania PUC seems to agree that these price effects are real and should be included in the TRC. On page 50 of its Final order on the 2011 Total Resource Cost Test, it states: "The Commission sees value in further analyzing the potential benefits that EDC DR programs may manifest via wholesale energy market price reduction. After all, such price reductions appear to be the underlying objective of the Act 129 DR mandates." We agree that further analysis should be done on this topic, not just for DR programs but also for the cost benefits of energy and demand reduction from traditional EE programs. We recommend that these values be agreed upon and included in the avoided costs for the 5-year period beginning June 1, 2013.

### Externality Adders

As outlined in above, there are very significant benefits associated with efficiency that are not captured in the traditional TRC test. As a result, many states with leading efficiency programs have been including adders in the avoided costs which recognize efficiencies' hard-to-quantify environmental and/or risk-mitigation benefits (see table below). Further, it is fairly likely that in the medium-term, a carbon cost will be imposed in order to encourage reductions in greenhouse gas emissions. A recent study of avoided costs for New England determined that the cost of $CO_2$ mitigation is likely to approximate $80 per ton over the next 15 years.[21] Future $CO_2$ mitigation costs are based upon the potential for new and existing technologies to reduce global carbon

[21] Biewald, B. et al, "Avoided Energy Supply Costs in New England", Synapse Economic, Inc., July 21, 2011. Exh. C-21.

emissions to achieve "sustainability" targets established by the IPCC.[22] Achieving such targets implies that the U.S. and other developed countries would need to reduce GHG emissions on the order of 80 to 90% below 1990 levels in order to stabilize atmospheric concentrations of $CO_2$ and other heat-trapping gasses to 400 to 550 ppm $CO_2$ equivalents.[23] The more efficiency that is done in Pennsylvania, the less costly any potential carbon tax, emissions trading scheme, or other air-pollution regulations will be. We recommend that Pennsylvania explore using an adder to reflect the real environmental and risk mitigation benefits from efficiency and to help guard against potential future emissions regulations.

## BUDGET CAP

The 2% budget cap represents an artificial limit on the benefits that efficiency can bring to Pennsylvania ratepayers. While it is understood that the intention of the cap was to protect customers from increased costs, the fact is that energy efficiency can be procured well below the cost of new supply-side resources and helps lower ratepayer bills. Also, efficiency can be an important mechanism to protect ratepayers from sudden rate increases, because it mitigates the effect of volatility in fuel prices. Further, since the cap is tied to 2% of 2005-2006 sales and does not increase with inflation or with increases in utility revenue over time, the efficiency procured as a percent of current sales will steadily deteriorate over time. As more customers are added to the utilities' service area, a smaller and smaller portion of the state will be able to benefit from the efficiency efforts and savings will grow smaller as a percent of sales.

Finally, the benefits of energy efficiency go beyond the savings accrued to the customer installing an energy efficiency measure and likely reduce rates for all ratepayers in the medium- to long-term. Reducing overall electricity demand in the state helps to delay expensive transmission upgrades and construction of new generation like gas peaking plants that rely on expensive fossil fuels with volatile prices. In addition, lower demand means that utilities can shed the most expensive electricity on the margin, lowering the cost of power for everyone in the state. Finally, there is already a mechanism in place to protect ratepayers. The utilities approved plans must pass a cost-effectiveness test, providing certainty that the monetary benefits outweigh any costs. We recommend that Pennsylvania remove the 2% cost cap to allow for more cost-effective energy efficiency savings to be realized by ratepayers.

## DECOUPLING

Under traditional regulatory structures, most utilities have an inherent disincentive to aggressively pursue capture of efficiency resources. Typically the main disincentives result from short term lost revenue (between rate cases), as well as reducing the need for new supply-side investments which can increase a utility's ratebase and therefore shareholder earnings. As a result, many states have been exploring decoupling as a way to separate electric sales from

[22] According to the IPCC 2007 report, Biewald, B. et al. p. 6-95.

[23] Scientist assume that concentrations of CO2 equivalents above 550 ppm would have a demonstrable effect on average global temperatures and exacerbate the impacts of Climate change on the environment.

utility revenue. Under decoupling there is a true-up mechanism that adjusts rates based on actual sales.[24] That is, if actual sales are higher than what was predicted in the original rate case, rates would be adjusted down, and if actual sales were lower, rates would be adjusted upwards. Under decoupling, utility revenues are based on what is needed to recover its costs plus a rate of return, and independent of the volume of electricity sales. There are very few reasonable circumstances where rate adjustments would be larger than 3%, but, even so, some jurisdictions have applied caps on the possible decoupling true-up in order to limit its magnitude.[25]

According to Act 129, "Decreased revenues of an EDC due to reduced energy consumption or changes in energy demand shall not be a recoverable cost under a reconcilable automatic adjustment cause." While this clearly rules out a lost-revenue recovery mechanism, it appears to leave the door open for decoupling schemes, which are fundamentally about how rates are set and fixed costs are recovered and are not directly related to efficiency. Under decoupling, rates are based on revenue targets set during rate cases and reconciled based on the actual amount of electricity sold, regardless of whether revenues vary from requirements due to weather, economic circumstances, efficiency efforts, or some other cause. In fact, many states without significant efficiency programs have implemented some form of decoupling, especially for gas utilities. For example, Wyoming began a 3-year decoupling program for Questar Gas Company in 2009, the Arkansas approved decoupling for its natural gas utilities in 2007, and Virginia allows decoupling for its natural gas utilities (but not electric).

Under the right circumstances, decoupling can be a powerful tool to eliminate utility disincentives from efficiency investment and therefore bring large benefits to the electric ratepayers. However, without credible commitment from the legislature, PUC, and other market-actors to invest in aggressive efficiency efforts, the benefits of decoupling may largely flow to the utilities, as their risk relating to effect on sales of the weather, economic conditions, or other factors is reduced. Currently, the legislated 2% cap on efficiency spending severely limits the potential benefits for ratepayers of increased efficiency efforts, and so decoupling would likely not provide significant ratepayer benefits. We would therefore recommend that Pennsylvania implement decoupling if and only if the 2% spending cap were lifted and there was a clear commitment to aggressively pursue energy efficiency.

## PERFORMANCE INCENTIVES

While decoupling removes the disincentive to invest in efficiency, it does not create a positive incentive for utilities to prefer demand-side investments to supply-side investments. In fact, at the margin, utilities are likely to prefer supply-side investments that are by their nature more expensive than cost-effective efficiency investments, and would therefore add more to the

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[24] Some states also have lost revenue recovery, where utilities are compensated for the evaluated net loss of revenue from efficiency. However, net-to-gross ratios can be contentious, calculated lost revenues often escalate to unsupportable levels due to the long lifetime of many efficiency measures, and utilities will still have a general incentive for load building outside of efficiency programs. For these reasons, we recommend decoupling as opposed to lost revenue recovery.

[25] ACEEE. Aligning Utility Interests with Energy Efficiency Objectives: A Review of Recent Efforts at Decoupling and Performance Incentives. http://www.aceee.org/sites/default/files/publications/researchreports/u061.pdf

ratebase. To this end, utilities in many states are eligible to earn a performance incentive (PI) if they are successful in implementing cost-effective efficiency programs. So far, 17 out of the 50 states have some form of performance incentive, including Arizona, Colorado, California, Georgia, Kentucky, Oklahoma, and New Hampshire. Performance incentives have proven to be a key factor in encouraging energy efficiency efforts and their corresponding benefits; a recent ACEEE paper concludes that, in 2009, states with a performance incentive spend an average of 42% more than states with no performance incentives but with other policies in place meant to remove the disincentives to efficiency investment.

Appendix C includes a detailed discussion of the various types of performance incentives and what goes into a successful performance incentive. When properly designed, performance incentives can ensure successful implementation of efficiency programs, build utility support for increased efficiency targets, and help achieve any secondary policy goals from efficiency (such as customer equity, demand reduction in transmission-constrained areas, deep savings in retrofits, etc.).

In a sense, the penalty of up to $20 million faced by Pennsylvania utilities for failing to meet Act 129 goals already serves as a basic performance incentive. From a purely financial opportunity cost perspective, the imposition of a penalty for failure to achieve goals is the same as the failure to win an award.[26] Indeed, the performance incentive mechanism in states such as California and New York include a penalty if utility savings are well below goals in addition to an award for above-target performance. In our opinion, the penalty incurred as part of Act 129 if the utilities fail to meet goals is a sufficient incentive to perform, and so additional performance incentives are not needed. Further, a major benefit to performance incentives is to build utility support for aggressive savings targets. However, the 2% spending cap neutralizes this potential benefit. It is possible that the prospect of a performance incentive could build utility support for legislation lifting this limit; performance incentives could also be used as an alternative way too compensate utilities for lost revenue if it is determined that decoupling implementation would need additional legislation. We believe that it may be beneficial to explore implementing a performance incentive if the spending cap is lifted or if it is seen as a key step en-route to lifting the spending cap, but that it is not necessary within the current spending constraints and penalty scheme. If a performance incentive is added, we recommend a performance target style incentive, designed according to the guidelines in Appendix C. One large advantage of performance incentives is that they can be set up to promote secondary policy objectives, such as to discourage cream-skimming and encourage market transformation.

## NET VERSUS GROSS SAVINGS

In Pennsylvania, the PUC has directed utilities to research appropriate net-to-gross (NTG) ratios. NTG ratios are important in determining what portion of program-reported gross savings

[26] From a financial opportunity cost perspective, a utility should be indifferent between a dollar lost and a dollar not earned. However, in actuality, it is likely utilities may respond more aggressively to avoid penalties than to earn awards simply because they perceive penalties as associated with failure, where awards are viewed as incentives for exceeding expectations. Of course, from a ratepayer perspective, penalties are preferable because they reduce the cost of EE and provide some funds back if the utilities fail to capture the planned EE.

is from freeriders, and thus how much of the savings is truly attributable to the ratepayer funded efficiency program. In the 2011 Total Resource Cost Test Order, the PUC explicitly rejects using NTG ratios to determine compliance targets, and instead suggests that they should be used only in the TRC test, as well as for generic "program design and implementation." We disagree with this conclusion, and urge that the NTG ratios found during the 2009-2013 period be used to determine compliance targets for the 2013-2018 period.

First, it is important to note that, if done properly, NTG ratios have only a minor impact on the TRC. This is because the TRC is meant to quantify only the costs and benefits to society that are directly attributable to the efficiency program. Therefore, if a participant is assumed to be a freerider, the benefits from the efficiency measure are not included in the TRC, but neither are the incremental costs, since they would have occurred even in the absence of the efficiency program. That the efficiency program is shouldering a portion of the costs rather than the participant is immaterial from a societal point of view. Therefore, the only difference in the TRC comes because the same admin costs are now supporting lower savings. In other words, if the NTG is 0.8, the numerator of the benefit-cost ratio is being reduced by 0.8, but so is most of the denominator (all costs except the admin costs). It therefore does not make sense to collect NTG data but only use it for the metric where it makes the smallest difference.

Second and more importantly, performance targets based on gross savings create a perverse incentive for utilities to focus too much of their effort on promoting technologies such as basic CFLs, which save a lot of energy and are highly cost-effective, but that are now being widely adopted in the marketplace and therefore have high freerider rates.[27] This is especially true in states such as Pennsylvania with no decoupling or lost revenue recovery: freeriders are not only much easier to reach, but also avoid lost revenue. In fact, with performance targets based on gross savings rather than net savings, the arguable best-case scenario for a Pennsylvania utility is to go after as many freeriders as possible. This will allow the utility to avoid the penalty associated with failure to meet Act 129 goals as well as avoid losing revenue due to increased efficiency.

## IMPLEMENTATION FLEXIBILITY

Currently, Pennsylvania utilities have limited ability to 1) switch funds between programs within the same customer class; 2) eliminate a measure that is underperforming 3) change the rebate levels for a measure; or, 4) change the eligibility conditions for a rebate for a measure. We believe that, like a successful business, a successful efficiency program needs to be able to respond to changing market conditions and learn from program experience in real time without the need for lengthy regulatory review. While the PUC has recognized the need for an expedited review process, we believe that small changes in program design should be allowed without this review as long as the overall program conforms to the original intent of Act 129. Thus we recommend real-time changes in program design be allowed without regulatory approval as long as certain general metrics are maintained. These metrics would likely include maintaining

[27] For reference, net-to-gross ratios for standard CFL bulbs are often below 50%.

funding equity between customer classes and ensuring that all measures and programs a TRC of greater than 1.

## CREAM SKIMMING

While cost-effective savings are vital for the success of any efficiency program, it is usually not the goal of policy makers to simply get the most savings for the cheapest possible amount. Rather, there are typically other goals related to the distribution of spending among customer classes, market transformation, local job creation, a certain share of savings coming from non-lighting measures, and others. As mentioned previously, there is a sense where Pennsylvania's focus on gross savings rather than net savings as well as the fairly cheap savings needed to achieve the goals may require 'cream-skimming.' This occurs when efficiency programs focus on the measures with the cheapest savings at the expense of other measures that may have greater net benefits over the long run. Cream-skimming can be a problem when:

- **It creates lost opportunities:** Cream-skimming may create lost opportunities when a program encourages one measure at the expense of another that may cost more but also saves more. Further, by focusing on the measure that already has fairly wide market acceptance, a cream-skimming efficiency program may miss an opportunity to transform a market towards a more advanced technology that is just starting to penetrate the marketplace.
- **It makes future projects less likely:** Oftentimes participants will have certain financial criteria based on simple payback, return on investment, or cashflow, that are required before he/she will commit to an efficiency project. If more expensive measures can be bundled with cheaper measure as part of a comprehensive project, then the cheaper measures will serve to offset some of the cost of the more expensive measures, and deeper efficiency savings will be realized from that customer. However, if only the cheapest measures are implemented during the first project, it becomes less likely that the other more expensive measures will be installed at a later date.

In order to guard against cream-skimming, 2013-2018 compliance should at least be measured with net savings as opposed to gross savings. Further, any performance incentive could contain stipulations to discourage this practice. These can include requirements for average depth of savings per customer, percent of portfolio savings achieved from non-lighting measures, minimum payback thresholds, etc.

## CONCLUSION

Energy efficiency offers states a unique opportunity to reduce their electric load, improve air quality, decrease electric bills, increase employment, stimulate local economic activity, and improve indoor comfort levels. More and more states are recognizing these benefits, and, as a result, dedicating themselves to acquiring all cost effective electricity.

Pennsylvania's Act 129 is a significant step towards capturing the potential benefits of energy efficiency. Efficiency efforts in the first two program years are already saving ratepayers $278 million dollars per year, will lead to emissions reductions the equivalent of taking 4 million cars off the road, and will create over 4,000 jobs for the state. If Act 129's first 4-year goals are met, total efficiency spending of $978.4 million will create $4.68 billion in direct consumer electric bill savings and create 14,676 jobs.[28,29] At a minimum, Pennsylvania's efficiency programs should be extended as described in the "constrained scenario," in order for ratepayers to continue enjoying this level of benefits. Further, if the budget cap were lifted, the annual savings would be able to scale up to roughly double what they are now, with a corresponding doubling of societal benefits. Under this "unconstrained scenario", total savings from June 1, 2013 – May 31, 2018 would reach 8.75% of projected 2011-2012 sales, there would be lifetime emission reductions equivalent to taking 25 million cars of the road for a year, and 40,351 job-years would be created.

In addition to extending and/or increasing Act 129, we believe that a few policy level changes would help fully promote energy efficiency, and encourage successful, cost-effective programs. In particular, we recommend changes in the TRC test such as lowering the discount rate, allowing fossil fuel savings, and allowing benefits to last more than 15 years. Further, we urge that future savings goals be based on net savings (i.e., excluding freeriders) rather than gross savings. Finally, if the spending cap is revoked, we recommend instituting decoupling and/or a performance incentive in order to avoid punishing utility shareholders for decreased energy sales. We believe that, with the changes mentioned in this report, Pennsylvania will become a national leader in energy efficiency programs.

[28] Using an average retail rate of 10.84 cents per kWh from EIA data, a discount rate of 7%, and a 13 year average measure life

[29] Assumes 15 jobs per $1 million spend on efficiency

## APPENDIX A: REVIEWED POTENTIAL STUDIES

Eldridge, Maggie, et al. *Potential for Energy Efficiency, Demand Response, and Onsite Solar Energy in Pennsylvania.* ACEEE, April 2009.

Eldridge, Maggie, et al. *Energizing Virginia: Efficiency First.* ACEEE, September 2008.

KEMA, Inc. *Rhode Island Energy Efficiency and Resources Management Council (EERMC): Opportunity Report – Phase I.* July 15, 2008.

KEMA, Inc. *New Jersey Energy Efficiency and Distributed Generation Market Assessment*. 2004.

Jensen, Val and Lounsbury, Eric. *Georgia Environmental Facilities Authority: Assessment of Energy Efficiency Potential in Georgia.* ICF Consulting, May 5 2005.

GDS Associates. *A Study of the Feasibility of Energy Efficiency as an Eligible Resource as Part of a Renewable Portfolio Standard for the State of North Carolina.* Submitted to the North Carolina Utilities Commission, December 2006.

Elliott, Neal R. et al. *Potential for Energy Efficiency, Demand Response, and Onsite Renewable Energy to Meet Texas's Growing Electricity Needs.* ACEEE, March 2007.

KEMA, Inc. *Potential for Energy Efficiency in Connecticut.* May 1, 2009.

Summit Blue Consulting, LLC. *Energy Efficiency Potential Study for the State of Kansas: Final Report.* Submitted to the Kansas Energy Council, August 11, 2008.

## APPENDIX B: TOTAL RESOURCE COST TEST COMPARISON

| | Type of test (1) | Discount Rate | DRIPE | Externalities Included (Risk, Emissions, etc.) | Emissions Compliance Costs? | O&M benefits | Water / Fossil Fuel |
|---|---|---|---|---|---|---|---|
| Vermont(2) | SCT | 5.7% (Real) | No | 10% and about $0.045 per kWh(3) | Yes | Yes | Yes |
| Massachusetts (4) | TRC | Yield from 10 year treasury note. Currently around 2%. | Yes | Yes, LI Only (5) | Yes | Yes | Yes |
| Connecticut | TRC | After-tax cost of capital (6) | Yes (7) | No | Yes | Yes | Yes |
| Rhode Island (8) | TRC | 7.00% | Yes | No | Yes | Yes | Yes |
| Maine (9) | TRC | Yield from long-term US treasury (10 years or more). Currently around 2%. | No | To the extent they can be reasonably quantified | Yes | Yes | Yes |
| California (10) | TRC | Weighted average cost of capital (11) | Yes (12) | $12.50/ton in 2008 and rising (12) | Yes | Yes | Yes |
| New Jersey (13) | TRC | Weighted average cost of capital | No | No | Yes (14) | Yes | Yes |
| Ohio (17) | TRC | ??? | No | No | | Yes | No |
| Ontario (18) | TRC | After tax cost of capital | No | No | Yes | Yes | Yes |
| Oregon (19) | SCT | 5.20% | No | 10% Risk Adder and $15/ton carbon | Yes | Yes | Yes |
| New York State(20) | TRC | 5.5% (21) | No | $15/ton | Yes | Yes | Yes |
| **Pennsylvania (15)** | **TRC** | **Weighted average cost of capital (16)** | **No** | **No (16)** | | **Yes** | **No** |

**Sources**

(1) *See;* "Savings Energy Cost-effectively: A National review of the Cost of Energy Saved through utility sector EE programs", ACEEE, Sept 2009, Report No. U092

(2) Efficiency Vermont Annual Plan 2009-2011. http://www.efficiencyvermont.com/docs/about_efficiency_vermont/annual_plans/EVT_AnnualPlan2009-2011.pdf

(3) 10% Risk Adder to EE resources. Also a current environmental externality value of 4.5 cents per kWh. http://www.narucpartnerships.org/Documents/krolewski_int_res_planning_en.pdf

(4) MA DPU Order 08-50-A. http://www.ma-eeac.org/docs/DPU-filing/08-50-A%20Order.pdf

(5) No environmental externalities may be added without legislative approval, but utilities are instructed to include the future costs of compliance with any state and federal regulations. There are externalities allowed for Low Income programs.

(6) 2010 CL&M Final Decision. Has been lower in the past, but Department will require a rate of no lower than 7% for 2011.

(7) 2008 CL&M Final Decision. Allows the inclusion of DRIPE, but needs to be separated out for reporting purposes.

(8) Rhode Island Energy Efficiency and Resources Management Council: Opportunity Report - Phase 1. http://www.rieermc.ri.gov/documents/OER-EERMC-OpportunityRept(7-15-08).pdf

(9) Efficiency Maine. 94-078. Chapter 2. http://www.efficiencymaine.com/docs/AgencyRules/Chapter2Update.pdf
(10)California: ftp://ftp.cpuc.ca.gov/puc/energy/electric/energy+efficiency/ee+policy/resource4.pdf
(11) EE Policy: http://docs.cpuc.ca.gov/efile/rulings/77462.pdf
(12) Avoided cost Rulemaking: http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/45284-03.htm#P245_42105
(13) Conversation with Frank from CEEEP. August 11th.
(14) New Jersey has recently dropped out of RGGI. However compliance costs from NOx, Sox, and other regulations are still included in the TRC.
(15) Pennsylvania Public Utility Commission. Docket No. M-2009-2108601. Final Order 2011 Total Resource Cost Test Order. July 28, 2011.
(16) Pennsylvania Public Utility Commission. Docket No. M-2009-2108601. Implementation of Act 129 of 2008 - Total Resource Cost Test.
(17) Ohio Cod 4901. http://codes.ohio.gov/oac/4901%3A1-39
(18) Ontario http://www.ontarioenergyboard.ca/documents/cases/EB-2008-0037/Board_Guidelines_for_CDM_20080328.pdf
(19) Energy Trust of Oregon. 4.06.000-P Cost-Effectiveness Policy and General Methodology for Energy Trust of Oregon.
(20) New York state. See DPS case 07-M-0548
(21) Real Discount Rate. http://www.dps.state.ny.us/07M0548/07M0548_Staff_Proposal_initial.pdf

# APPENDIX C: PERFORMANCE INCENTIVES

## KEY ELEMENTS OF UTILITY PERFORMANCE INCENTIVES

Below are some key factors or variables that must be considered to effectively design a shareholder incentive mechanism. They are summarized in the table below, with more detailed discussions following.

**Figure 1: Overview of Key Elements**

| | |
|---|---|
| **Level of Financial Reward** | Rewards of 4-8% are typically sufficient to encourage utility performance. It is easier to evaluate the size of the reward when it is based on program budget, rather than net benefits or an increased rate of return |
| **Performance Based** | Incentives should be based on actual measurable and verifiable performance to avoid perverse utility incentives. |
| **Multivariate** | Multiple metrics should be used other than savings in order to discourage cream-skimming and to promote secondary policy objectives |
| **Scalable** | Incentives should scale with performance to encourage performance even once goals have been met (or once it is clear that goals will not be met) |
| **Penalties vs. Awards** | Some states, especially in the West, impose penalties instead of or in addition to awards. Penalties may encourage extra effort to meet goals, though in practice they are very rarely incurred. |
| **Minimum Criteria** | Almost all PIs have a minimum threshold below which no incentive is given. Some also use additional minimum qualifying criteria that don't carry any financial incentive themselves. |
| **Evaluation, Monitoring, & Verification** | In order for shareholder incentives to actually encourage performance, goals must be set to be aggressive but reachable, and performance metrics must be verified by an independent third party. |

## LEVEL OF FINANCIAL REWARD

Given the purpose of PIs is to effectively encourage exemplary performance in capturing efficiency resources, a fundamental starting point is to understand the current regulatory structure, efficiency mandates if any, and the financial impacts (both positive and negative) to the utility from efficiency. PI financial rewards should be structured to ensure they are sufficient to effectively motivate utilities, while striving to avoid higher than necessary costs to ratepayers. Experience indicates that rewards in the range of 4-8% of total efficiency portfolio budgets have been sufficient to capture utility staff attention and provide a significant motivator. As is described in the best practices section, the incentives in the states with the most aggressive efficiency programs typically fall within this range, and in Vermont the incentives amount to only 3% of program spending.[30] Some utilities have argued for much higher incentives (sometimes greater than 100% of spending), however there is little evidence that levels greater than 10% at most are necessary for effective motivation. It is worth noting that just the existence of PIs, even when relatively small dollars are tied to a particular metric, can have a very significant motivating factor. For example, many utility staff will be given internal goals that focus on meeting exemplary levels of performance related to PI metrics, and become highly motivated to meet them regardless of the actual impact to the utilities financial bottom line. Similarly, imposition of penalties can often have a large motivating factor because utilities may view a penalty as more negative than failing to earn a reward.

In setting the level of incentives, one should analyze the potential financial and regulatory risk to the utilities, as well as any relevant legislative or regulatory mandates. For example, in Illinois utilities have no shareholder incentives, but instead are mandated by legislation to meet certain goals and failure can result in financial and other penalties.[31] Many stakeholders in Illinois view the mandate to perform efficiency as sufficient motivation and therefore do not support additional ratepayer funding going to the shareholders for what they have to do anyway. In an environment where a utility has wide discretion in setting goals and investments in efficiency more generous rewards may be deemed necessary to encourage aggressive efforts.

Throughout this document, the term "rewards" is generically used to indicate any financial or other incentive that could be positive or negative. We recognize that PIs can include financial or other penalties as well as awards, and discuss this issue below.

## PERFORMANCE BASED

While it is convenient to think about the level of financial reward in terms of a percent of program budgets, actual reward mechanisms where reward amounts are a function of spending or budgets at best fail to focus attention on the real purpose—performance— and at worst can create perverse incentives. For example, if tied to actual spending (as the current NH PI mechanism is), it provides the utility an incentive to be less cost efficient and spend more funds than may be necessary to increase rewards.

PIs should be tied directly to actual outcomes, and where possible avoid rewards for simply undertaking specific actions. Performance parameters should be objective, unambiguous, measurable, and verifiable (through EM&V procedures). Focusing on actions rather than performance can result in utilities doing things simply to achieve a PI, rather than focusing on maximizing the ultimate effects of any actions. For example, simply rewarding a utility for conducting a study, offering a trade ally seminar, etc. may encourage unnecessary actions, and

[30] Hayes, Sara, et al. Carrots for Utilities: Providing Financial Returns for Utility Investments in Energy Efficiency. ACEEE. January 2011.

[31] Senate Bill 1592. http://www.ilga.gov/legislation/publicacts/fulltext.asp?Name=095-0481&GA=095

also removes the utility focus on ensuring any actions taken result in positive outcomes. In some instances early on in a utility's tenure offering efficiency programs a few action-related metrics may be justifiable to ensure important steps are taken by the utility deemed essential for ultimate success.[32] However, whenever possible it is best to identify the desired outcomes from these proposed actions and articulate the metric in a way that holds the utility accountable to results. This also allows program administrators a level of flexibility in determining the most appropriate actions that will lead to success rather than being committed to something that was originally planned but perhaps later determined to be less worthwhile.

## MULTIVARIATE

Regulators and policy-makers typically have numerous objectives and goals related to efficiency portfolios. Clearly one primary goal is achievement of cost-effective energy savings. However, it is rarely the only policy objective. In addition, many objectives may create some tension — possibly pushing or pulling in opposite directions. For example, a single goal of maximizing energy savings can create a perverse incentive to "cream skim" by focusing only on those resources that are easiest and cheapest to capture. This can undermine other objectives such as to achieve deep and comprehensive savings in buildings; or market transformation in the future; or equity by focusing on low income and hard to reach customers.

PIs should therefore be multivariate, and use a number of different metrics, with varying weights in terms of reward, to provide a fuller, more complex structure of reward and focus for utilities. Typically the highest weight is applied to a primary goal or goals, such as net savings or net benefits achieved. However, it is critical to have other metrics that provide countervailing influences to protect against a singular focus and encourage a comprehensive approach to efficiency portfolios that balance many important and potentially competing policy objectives. Effective PIs may typically have a large share of earnings on the few primary interests, with a handful of other metrics offering smaller earnings or penalties that *in toto* provide a balanced perspective.

In establishing PIs, the first step is to comprehensively consider the primary and secondary objectives of efficiency portfolios. In addition, it is important to identify where these objectives may be either: 1) correlated; 2) opposing; 3) reinforcing; or 4) independent. For example, dollar benefits and electric savings may be highly correlated because typical electric efficiency programs derive the vast majority of benefits from the electric avoided costs. Therefore, while maximizing both the parameters may be important objectives, it may not make sense to have separate metrics and rewards for both. Alternatively, one may desire to focus on both but should then consider the overall weight applied to them collectively when considering importance. On the other hand, opposing objectives such as capturing savings cheaply vs. capturing deep and comprehensive savings may both be important criteria. Therefore, focusing solely on one may result in perverse incentives that undermine the other.

While multiple metrics are worthwhile, too many metrics with small rewards can divert focus and increase risk to the utility unnecessarily. A balance should be achieved that ensures

[32] These can also be considered for minimum qualifying criteria, as discussed below.

some focus on important policy objectives, while maintaining simplicity and primary focus on the overarching objectives. Typically, a large portion of total award will be on the few primary objectives, with at most a handful of smaller ones with secondary objectives.

### SCALABLE

Financial rewards or penalties should be scalable. In other words, the better the performance is the higher the reward should be. A single target where a utility either achieves a reward or not can result in perverse incentives. For example, if a utility is overachieving and meets its annual goal for a reward early, they may relax and not continue to aggressively pursue even better performance. Similarly, if a utility realizes they will not be able to reach the target three months early they may decide not to try as hard to come close. Scalable rewards provide on-going incentives to strive for the best outcome regardless of likely final performance. It also is viewed as fundamentally fairer, and lowers the risk to the utility. This lowered risk should be considered in the overall context of setting goals and levels of reward.

In scaling metrics, one should think about a starting (or threshold) level, a band within which rewards are scalable, and perhaps an upper cap on rewards. Below the threshold level a utility would earn no reward, or perhaps be exposed to a penalty. Threshold levels in recent PI mechanism have tended to range from65% - 85% of planned performance goals. Typically scaling of rewards once a threshold level is reached is done in direct proportion to the performance outcome. However, more complex scaling methods can be used to more heavily weight exemplary performance beyond the design levels. For example, one might structure a PI mechanism so that outcomes up to the design performance goals result in relatively low rewards, with much more generous rewards for utilities that exceed the design goals.

Many existing metrics that rely solely on rewards rather than penalties will design PIs so the utility earns the target level of financial reward if they meet 100% of the design (planned) goals. However, some stakeholders perceive meeting the plans as relatively expected and would prefer to target most of the financial rewards for truly exemplary performance. How one sets targets and financial reward levels should be considered along with the considerations around current regulatory structure, efficiency mandates, aggressiveness of the goals and budgets, risk exposure to the program administrators, and other related issues.

One should give consideration to reward caps. In theory, with scalable metrics one might want to allow unlimited rewards for unlimited performance achievements. This generally will most consistently support goals in jurisdictions where the pursuit of all cost-effective efficiency is desired, and should be considered. However, unlimited rewards can present challenges in some regulatory structures by potentially permitting unlimited ratepayer contributions that can not be planned and approved in advance. For this reason, many PIs will cap the ultimate rewards, typically around 110%-125% of design level targets. The ultimate level of any cap imposed should be set in consideration of the stringency of the goals, the level of risk in meeting or exceeding them the utility faces, the process by which goals are set and evaluated, and the possibility of extraordinary overachievements.

## PENALTIES VS. AWARDS

As discussed above, PIs can include both direct financial penalties and awards, and possibly other non-financial incentives.[33] Fundamentally, these can all be viewed the same way – the avoidance of paying a penalty can be seen as the same incentive as earning the correspondent amount, from a purely financial opportunity cost perspective. The regulatory and political environment will likely inform decisions about whether to offer a range of penalties and awards, or only one or the other. Many utilities will see penalties as unfair; however, it is likely they will create similar incentives for performance as awards, as avoiding spending a dollar should provide the same net result as earning a dollar.[34] Different stakeholders will have different views on this issue. Fundamentally, one must consider issues such as: if a utility spends all the budgeted ratepayer funds but fails to capture a reasonable amount of efficiency with it, should the shareholders be held responsible for some of this wasteful spending, or should ratepayers incur the full cost even though they received little benefit? Typically, full cost recovery of efficiency program expenditures is awarded to utilities unless clear evidence or imprudent action is uncovered. Therefore, regulators may decide that there should be some protection to ratepayers if utilities fall below some threshold level of performance.

## MINIMUM CRITERIA

Another mechanism to consider in a PI framework is adoption of *minimum qualifying criteria*. While most metrics should allow for scalable rewards, there may be some policy objectives that are viewed as critical to the efficiency portfolio and therefore must be met for a utility to be eligible for *any* rewards. For example, a jurisdiction may want to ensure a relative level of geographic equity throughout its territory as a prerequisite for rewards. Or possibly a minimum level of effort targeted to low income customers. Often if there are important milestones that stakeholders want a utility to achieve (e.g., setting up a database, having independent evaluations performed, etc.) that may not by themselves warrant financial rewards, but are deemed necessary but not sufficient to successful performance. Minimum qualifying criteria can be viewed as a a threshold level before which *any* awards are deemed earned. If used, minimum qualifying criteria should be designed carefully. Generally they should reflect things that are within the utilities control and don't have huge risk of failure. If a utility is unable to meet a minimum criterion and knows this, it can create a large perverse incentive in that it can render other metrics moot.

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[33] For example, Illinois utilities face a potential penalty of the State taking over delivery of EE programs if they fail to meet goals over a three year period. Legislation ILCS 5/8-103 (http://www.ilga.gov/legislation/ilcs/fulltext.asp?DocName=022000050K8-103)

[34] From a financial opportunity cost perspective, a utility should be indifferent between a dollar lost and a dollar gained. However, in actuality, it is likely utilities may respond more aggressively to avoid penalties than to earn awards simply because they perceive penalties as associated with failure, where awards are viewed as incentives for exceeding expectations. Of course, from a ratepayer perspective, penalties are preferable because they reduce the cost of EE and provide some funds back if the utilities fail to capture the planned EE.

## EVALUATION, MONITORING & VERIFICATION

While not specific to PI mechanisms *per se*, EM&V plays an important role in development and administration of PIs. As mentioned above, performance metrics should be clear, objective, measurable and verifiable. For PIs to be successfully designed, performance goals should be negotiated or set in a manner that ensures design level targets are aggressive but achievable, and supported by budgets at a reasonable level. If goals are significantly easy to achieve and exceed, PIs will lose their effectiveness at encouraging exemplary performance. The level of goals and utility capability should be considered when setting target levels for reward, as well as the overall scaling mechanism, caps, and financial reward levels.

Similarly, for PIs to be effective and ensure ratepayers are protected, it is important that an independent process is used to measure and verify final achievements and rewards. While typically utilities will self -report achievements, these reports should be based on independent evaluations, be transparent, and at a minimum undergo a detailed review and verification process to ensure accuracy and accountability.

## TYPES OF PERFORMANCE INCENTIVE FINANCIAL AWARD MECHANISMS

Performance incentives are typically categorized as one of three types. Recently, Duke Energy has proposed a fourth type of incentive, called "Save-a-Watt," which provides a single mechanism for providing funding to administer the efficiency program, make up for lost revenue, and provide a shareholder incentive. So far, the Save-a-Watt model has only been implemented in Ohio, but Duke has applied to adopt the program in Indiana and Kentucky, and reapplied in North and South Carolina, after the initial application was rejected in both states. Fundamentally, these variations pertain to the way financial awards are calculated and applied. So, in theory all of the above issues can be addressed successfully under any of these models. However, while there is considerable flexibility within each type of PI as the amount, size, and manner in which the incentive is offered, each type has its own set of special considerations. The following table provides a brief overview of each of the four types of performance incentives in use in the United States.

**Figure 2: Performance Incentive Comparison**

| Type | Description | # of States | Advantages | Disadvantages | Average incentive as a % of EE budget |
|---|---|---|---|---|---|
| Shared Savings | Incentive is given as a percentage of net benefits from EE | 11[35] | • Incentive automatically scales continuously with net benefits.<br>• Naturally awards for amount of net benefit produced, rather than amount spent | • Evaluating net benefits is not a science, and can be contentious, resulting in greater need for formal evaluations and potentially more disagreements<br>• Can often lead to higher incentives than necessary to encourage utility performance<br>• In practice tends to discourage focusing on other important objectives by setting award levels based on net benefits only. However, in theory other metrics could be designed and included, with the net benefits simply identifying the total pot of funds to potentially be awarded, rather than guaranteeing the amount just for obtaining net benefits. | 14% of program spending |
| Performance Target | Incentive is tied directly to various performance metrics. Total amount of eligible incentive typically developed prior to implementation and not a function of share of net benefits, rate of return, or some other formula. | 6 | • Straightforward to set multiple performance metrics based on multiple policy goals.<br>• Easy to provide incentives for goals that are difficult to measure<br>• The amount of the potential incentive is transparent and easily calculated<br>• Allows regulators to set limits on incentive amounts and protects ratepayers from excessive and unanticipated earnings. Keeps earnings independent of other utility issues such as supply-side investments. | • Incentive amounts typically capped, so less incentive to continue to perform after reaching a maximum. | 6% of program spending |

[35] Washington State has a shared savings and a performance target component to its incentive, and is included in both categories

| Type | Description | # of States | Advantages | Disadvantages | Average incentive as a % of EE budget |
| --- | --- | --- | --- | --- | --- |
| Rate of Return | Allows the utility to earn their allowed rate of return or higher on EE program costs, or to earn a bonus rate of return based on EE performance | 1 | • Arguably puts efficiency spending on equal footing as supply-side investments<br>• Can be attractive to utilities because can potentially provide large profits and most visible to shareholders and financial community | • Supply-side investments are often still more attractive, due to larger size.<br>• Incentives calculations can become very complex.<br>• Difficult to apply minimum performance metrics to incentive.<br>• Incentive is not paid out immediately.<br>• Potential for utilities to earn very large windfall profits exists if not designed very carefully because can tie to total utility earnings on a very large ratebase<br>• Does not work for non-utility program administrators. | N/A |
| Save-a-Watt | Allows the utility to earn a percentage of their authorized rate of return on avoided supply-side costs due to EE programs. | 1[36] | • A single mechanism provides for program costs, lost revenue recovery, and performance incentives<br>• Arguably puts EE on a more equal footing with supply, by allowing utility to earn most of the value compared to what would have been spent on supply-side resources | • Can be much more expensive to ratepayers than other types of PIs. Typically provides most of the value of EE to shareholders rather than ratepayers, although in theory it could be designed to offer similar award amounts<br>• Difficult to apply minimum performance metrics to program.<br>• Incentive not paid out immediately<br>• Potentially difficult to administer, as avoided costs and other factors can change, resulting in more potential for disagreements. | N/A |

## Shared Savings Model

The shared savings model is currently the most commonly implemented type of performance incentive. Under the shared savings model, utilities receive a percentage of the net economic benefits from the efficiency program. Key considerations when implementing a shared savings performance incentive include:

- **Performance Based:** A key advantage of the shared savings model is that it is inherently performance based. Since maximizing net economic benefits is the primary goal of most efficiency programs, shared savings incentives naturally align utility incentives with this major policy objective.
- **Multivariate:** Shared savings incentive mechanisms naturally encourage both savings and cost-effectiveness. This is because the more cost-effective an EE program, the greater the benefit (and thus the incentive) will be for the same amount of program spending. Adding other goals, for example relating to market transformation, is theoretically possible though rarely implemented. This is partly because it can be difficult to estimate the ultimate fiscal impact of, for example, increasing the percent of net benefits received. As a result, it is difficult to provide a balanced portfolio of policy incentives under this approach. For example, a shared savings model can encourage cream skimming at the expense of comprehensive savings. In theory, one can use the shared savings model simply to define the total amount of funds eligible for award, with multivariate metrics to encourage other objectives to earn a portion of the award. However, this approach effectively will end up similar to a performance target mechanism.
- **Scalable:** Shared savings incentives naturally scale linearly with the amount of economic benefits. In most implementations, the percentage of the benefits received also increases once certain savings thresholds are passed. For example, a utility may receive 6% or net benefits for achieving 85%-100% of the goal, but 8% of net benefits for achieving over 100% of the goal. To protect ratepayers from having to pay out very large amounts, the total incentive is often capped at a percent of program spending (as opposed to net benefits).
- **Evaluation, Monitoring & Verification:** The size of the incentive is highly dependent on evaluated net economic benefits. This creates many potential areas of contention, such as net-to-gross ratios, how non-energy benefits are included and calculated, the precise definition of net economic benefits, and how the third party EM&V process will be used to adjust savings claims. This is a key disadvantage of the shared savings model; in California, for example, the evaluators found much lower net-to-gross ratios than anyone had expected. The resulting reduction in net benefits created uncertainty as to whether the minimum performance threshold for an incentive was even reached, and the resulting controversy caused long program delays. In order to avoid uncertainties such as this, it is important to set clear expectations as

to how net benefits will be measured and how reported savings will be adjusted based on evaluation results. These issues apply to any model, however, tying incentive amounts directly to net benefits fundamentally raises the importance of some issues around uncertainty, such as avoided costs, cost-effectiveness calculations, certainty of non-energy benefits, etc.

## Performance Target Model

The performance target model is the second most implemented type of performance incentive. Under this model, the total incentive amount is defined up front, and awards are dependent on the utility's ability to reach one or more performance metric such as energy savings. In practice, many jurisdictions set the total incentive amount as a percentage of EE portfolio funding; however, the earnings are tied to performance. Many of the leading states for efficiency use the performance target incentive due to its ability to transparently allocate incentives based on multiple performance metrics, and its ability to clearly define potential costs to ratepayers. Key considerations about the performance target model include:

- **Performance Based:** Although it is conceivable that a utility could receive a percent of total program costs regardless of its ability to reach performance goals, this does not happen. Indeed, the name Performance Target implies that the incentive is only available if some minimum performance is achieved. Care should be taken to avoid designing a PI mechanism that gives awards for simply performing certain actions rather than achieving measurable outcomes.
- **Multivariate:** It is very easy to apply multiple performance targets as a condition to getting the full incentive. For example, if the PUC believes that one goal is twice as important than a secondary goal, then, for a total incentive of 9% of efficiency spending, 6% would be available for meeting the primary target and the other 3% would be available for meeting the secondary target. As an added advantage, it is very easy for utilities and other stakeholders to calculate in advance how much money is at stake for meeting each target.
- **Scalable:** The performance target incentive is not quite as naturally scalable as the other incentive models. However, it is very easy to make the incentive scale with increasing performance in each metric, and this is typically done.
- **Evaluation, Measurement, and Verification:** While similar controversies over net-to-gross ratios exist in the performance target model and the shared savings model, the contention is somewhat mitigated since the incentive amount is not typically so intertwined with net economic benefits. Further, issues regarding non-energy benefits, cost-effectiveness screening methodology, and avoided costs are often avoided entirely.

## Rate of Return Model

The Rate of Return model was very common in the 1980s, but has fallen out of favor as efficiency expenditures are not typically capitalized anymore. This model was in use until recently in Nevada, where it has now been replaced by a lost revenue recovery mechanism, and in Wisconsin, where it only applies to a single low interest loan program for C&I customers, run by Wisconsin Power & Light. Under the rate of return model, all efficiency expenditures are capitalized over the average life of the measures installed, and earn a similar rate of return as supply-side investments. In Nevada, in addition to recovering program costs through rates, the utilities could earn a rate of return on the investment 500 basis points over the allowed rate of return for supply-side investments. The supposed benefit of this approach is that it puts efficiency on equal financial footing with new supply. However, many argue that supply side investments are still more attractive financially than efficiency, since supply side investments are usually much larger in size, and therefore offer much higher total potential earnings.

A twist on the above rate of return model that has been proposed does not capitalize EE investments as part of the ratebase utilities earn a rate of return on, but rather provides an incentive in the form of some additional basis points added to the current utility rate of return on its existing ratebase. This approach can be viewed as simply defining the total incentive award differently, and can be designed to look very similar to a performance target or shared savings model in practice. However, because a utility's total ratebase is typically far larger than EE investments, extreme care must be taken to ensure that the basis point adjustments are extremely small, and do not result in unanticipated large windfalls to utilities from small improvements in EE performance. For this reason, other models are generally preferred.

- **Performance Based:** While it is theoretically possible to make a rate-of-return incentive performance based, the formulae may get fairly complicated. Both states currently giving rate of return incentives give the same incentive regardless of actual program performance. As a result, these mechanisms tend to focus on spending rather than performance.
- **Multivariate:** While it is theoretically possible to create a multivariate incentive structure, the calculation will get fairly complex, and no examples currently exist.
- **Scalable:** Rate of return incentives scale with program spending, typically regardless of the actual savings. This potentially creates a situation where the utility has a financial incentive to run expensive but less cost-effective efficiency programs.
- **Evaluation, Measurement and Verification:** Since energy savings targets are not usually included in this incentive mechanism, any EM&V activities will not affect the size of the incentive.

### Duke's Save-a-Watt Model

In 2007 in North Carolina, Duke Energy proposed a unique performance incentive mechanism it called "Save-a-Watt." Duke argued that in order for energy efficiency to be viewed as equivalent to supply-side investment, a utility would have to be compensated in an amount roughly equal to what it would have spent on supply-side resources in the absence of efficiency programs. Thus the proposed Save-a-Watt model would compensate Duke 90% of the net present value of the avoided costs of the efficiency program. This sum of money would be enough to cover program expenses, lost revenue recovery, and shareholder incentives. In essence, Duke proposed that 90% of the benefits of EE accrue to shareholders, with only 10% being retained by ratepayers.

The Save-a-Watt Model has the significant disadvantage that it makes efficiency almost as expensive as supply to the ratepayers. Further, this structure arguably makes efficiency much more financially attractive than supply-side investment, since most of the avoided costs represent costs for the materials and labor for power plants, and not profit for the utilities. Therefore, a large portion of the costs avoided thanks to efficiency that would otherwise have gone into the material, labor, and fuel for new supply, can now be kept as profit for the utilities. In theory, the model could be used with a lower portion of avoided costs accruing to shareholders, and designed to offer similar awards as other mechanisms. However, even then, this model can encourage cream skimming and result in other perverse incentives.

The original Save-a-Watt program got rejected by the PUCs of North and South Carolina. However, Ohio has adopted a version which enables Duke to receive 50% of avoided energy costs, and 75% of avoided demand costs. On top of this, Duke will receive lost revenue recovery for at least the first three program years. The model is quite controversial in Ohio, and the lost revenue recovery mechanism is currently being challenged by the Ohio Consumers' Counsel. Furthermore, measuring energy savings is extremely contentious under the Save-a-Watt model, as the entire premise of the model falls apart if the efficiency programs aren't actually avoiding new supply. Nevertheless, Duke is pushing ahead with implementation – it has applied to implement the program in Indiana and Kentucky, and reapplied in North and South Carolina.

- **Performance Based:** The size of the incentive is inherently tied to avoided costs, which increase directly with the kWh and kW savings. This creates a natural alignment of utility incentives and a major policy goal. Further, significantly under-performing efficiency programs have the potential to not even recover full program costs.
- **Multivariate:** Since the Save-a-Watt mechanism is designed to pay for program delivery, lost revenue recovery, and performance incentives, it can be very difficult to separate in advance the portion of the award that is profit to the utilities from the portion that is used for lost revenue recovery and program administration. Since the avoided costs are capitalized and earn a ROI, it is theoretically possible to increase the earned ROI based on performance in secondary metrics. However, these calculations can become even more complex and opaque than in the rate-of-return model, since even the amount of funds to be capitalized is unknown in advance. This makes it very difficult to design a save-a-watt type mechanism that does not simply encourage cream skimming, or that focuses attention on other policy objectives.
- **Scalable:** The amount of money received from the Save-a-Watt model naturally scales with avoided costs, and thus kWh and kW saved. The Ohio version provides another layer of scaling by increasing the earned ROI on the

capitalized avoided costs in tiers as the efficiency goals are met and exceeded. However, as noted above, if pursuing a multivariate approach that encourages addressing other policy objectives besides capturing maximum avoided cost benefits, scaling becomes difficult because the amount of money available is integrally tied only to a single metric.

- **Evaluation, Monitoring & Verification**: Since the "Save-a-Watt" model typically distributes a much greater portion of the benefits to shareholders, rather than ratepayers, it is vital that all stakeholders are confident that the benefits claimed are real, and that the efficiency programs are in fact avoiding supply-side costs. Under this model, the precise value of uncertain parameters such as net-to-gross ratios and avoided cost definitions can make an enormous difference to the utilities bottom-line, and thus the M&V process is likely to be quite contentious.

## Distribution of Benefits

One important policy consideration when designing performance incentives is how much of EE's benefits should go to utility shareholders versus the ratepayers. The larger the incentive, the more of the net benefits from efficiency flow to the utility stockholders (or non-utility program administrators), rather than showing up as lower electric bills. Each type of incentive clearly has lots of flexibility as to how large the incentive will be. However, as commonly implemented, the four types of PIs show different approaches to distributing efficiency's benefits.

A 2008 LBNL study[37] quantitatively examined the effect of each performance incentive model, as commonly implemented, on utility earnings, and the total resource cost and benefits of efficiency programs. Some key findings include:

- Assuming equal performance of EE programs under all models, ratepayers see the most benefits with no performance incentive, followed by a performance target, cost capitalization, shared net benefits, and finally Save-a-Watt.
- Compared to EE without an incentive, the performance target model raises the total resource cost by 10%, cost capitalization model by 20%, Shared Net Benefits by 35%, and Save-a-Watt by 160%
- EE does not pass the total resource cost test under the Save-a-Watt model, and utility earnings under this model are significantly higher than what they'd be with no efficiency.[38]

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[37] Cappers, Peter, et. Al. Quantitative Financial Analysis of Alternative Energy Efficiency Shareholder Incentive Mechanisms. Ernest Orlando Lawrence Berkeley National Laboratory. 2008.

[38] Essentially, if one assumes the payments to the utility under Save-a-Watt reflect the "costs" of the program, then unless they are a small percentage of avoided cost benefits, the addition of customer contributions to efficiency tend to result in a total cost of greater than the avoided cost benefits. As a result, while the savings are cheaper than supply, the ratepayers ultimately spend more than supply to procure the savings.

It is important to note that the ACEEE findings are based on current practices, and in some cases the findings are not inherent in the models, so much as in the typical application of these models. For example, the Save-a-Watt model might show much more favorable results to ratepayers if the percent of avoided cost awarded to the utility where much smaller. However, it is not clear this would provide sufficient motivation to the utility, and the models do tend to lend themselves to fundamentally different approaches.