

## A Model Portfolio for Pennsylvania Energy Efficiency Programs under Act 129 Phase III

Prepared for



by



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## EXECUTIVE SUMMARY

This paper presents a model portfolio that can be used as a guide for how Pennsylvania's efficiency programs can evolve going forward. Note that this model is meant as a general guideline of the path forward, and not as a set of specific goals or prescriptions for future programs. Although acquisition costs are higher for this portfolio than what is being currently achieved, we believe that this is a worthwhile tradeoff for deeper and more comprehensive programs. This is especially true since the costs in the model portfolio are similar to the budgeted cost per kWh in PY 5 – the PAs were significantly under budget, so the actual costs are lower than the budgeted costs. Further, if Pennsylvania EDCs reported lifetime savings, we would likely see a much smaller difference in cost, because the model portfolio promotes a higher proportion of longer-lived measures. Finally, although this portfolio is based on analysis of actual program data and other information, it is presented for illustrative purposes. Further analyses and conversations with the EDCs are needed to develop actual spending and savings targets.

The table below summarizes the model portfolio with the Pennsylvania Program Year 5 results and the targets from the commission order. Note that "C&I" in the table refers to both the Commercial and the Industrial sector combined. As seen, there are a several differences between the portfolios:

- The cost per kWh in the model portfolio is higher than either the PY 5 results or the commission order
- As a result, the model portfolio achieves lower annual savings than the other two scenarios, given the budget constraint.
- The tradeoff for lower annual savings is a much higher portion of savings coming from more comprehensive measures. As seen, many of the existing EDCs get their savings almost entirely from lighting measures, which is not ideal for creating sustainable efficiency programs.
- For the model portfolio we present estimated lifetime energy savings. A comparable value for the PY5 portfolio or the commission order are not available. However, we do estimate the approximate lifetime savings from the current PY 05 portfolio. Note that even though the PY5 portfolio produces more annual savings, it gets lower savings on a lifetime basis. However, this is a high level estimate, and actual lifetime savings from the PY5 portfolio could vary. To reduce this uncertainty, we recommend that this important metric should be reported going forward. Reporting lifetime savings would give a more holistic view of the portfolio, and help create a portfolio that better correlates with economic benefits.
- The lifetime for some programs in the model portfolio is lower than typical, due to the requirement in Pennsylvania that no measure have a lifetime of greater than 15 years. Without this requirement, the lifetime savings would be even higher.

- The model portfolio has a much higher portion of savings coming from the commercial & industrial (C&I) sectors than the other two scenarios. Costs are typically lower for C&I, in part because a very high portion of the usage tends to be concentrated at a small number of facilities. Further, C&I customers tend to use proportionally more electricity than residential customers. According to the EIA, the C&I sector accounted for about 63% of total statewide electric use in 2013.<sup>1</sup> However, due to lower prices in the C&I sector, this translates into about 51% of electricity expenditures.<sup>2</sup> To the extent that Pennsylvania has regulations requiring sector equity, the distribution of savings in the model portfolio may have to be revisited. Note that an increase in savings in the residential or low income sectors would increase total acquisition costs.
- Note that, although the portfolio needs to offer more than lighting and behavioral programs, these are still very important elements of the portfolio. There is evidence, for example, that behavioral programs may actually have a longer than one year measure life, and that they increase participation in other programs. This is seen in the portfolio, where 11% of total savings is achieved through behavioral programs, more than currently achieved by some EDCs.

|                              | Comparison   | PA PY 05         | Model Portfolio  | Commission Order |
|------------------------------|--------------|------------------|------------------|------------------|
| Percent of total savings     | Residential  | 60%              | 40%              | 59%              |
|                              | Low Income   | 4%               | 3%               | 6%               |
|                              | C&I          | 35%              | 57%              | 35%              |
| \$/annual kWh                | Residential  | \$ 0.12          | \$ 0.27          | n/a              |
|                              | Low Income   | \$ 0.42          | \$ 0.41          | n/a              |
|                              | C&I          | \$ 0.15          | \$ 0.20          | n/a              |
|                              | <b>Total</b> | <b>\$ 0.14</b>   | <b>\$ 0.24</b>   | <b>\$ 0.184</b>  |
| Total Annual Savings (MWh)   | Residential  | 569,264          | 355,389          | 721,543          |
|                              | Low Income   | 43,704           | 26,654           | 67,362           |
|                              | C&I          | 390,132          | 506,429          | 435,863          |
|                              | <b>Total</b> | <b>1,003,100</b> | <b>888,472</b>   | <b>1,224,768</b> |
| Total Lifetime Savings (MWh) | Residential  | 3,761,850        | 2,740,321        | n/a              |
|                              | Low Income   | 453,524          | 257,189          | n/a              |
|                              | C&I          | 4,069,869        | 6,204,133        | n/a              |
|                              | <b>Total</b> | <b>8,285,243</b> | <b>9,201,643</b> | n/a              |

<sup>1</sup> [http://www.eia.gov/state/seds/sep\\_fuel/html/pdf/fuel\\_use\\_es.pdf](http://www.eia.gov/state/seds/sep_fuel/html/pdf/fuel_use_es.pdf)

<sup>2</sup> [http://www.eia.gov/state/seds/sep\\_fuel/html/pdf/fuel\\_pr\\_es.pdf](http://www.eia.gov/state/seds/sep_fuel/html/pdf/fuel_pr_es.pdf)

|   |             |     |     |                  |
|---|-------------|-----|-----|------------------|
| Percent of prescriptive program from lighting (PPL) | Residential | 97% | 59% | 36% <sup>3</sup> |
|   | C&I         | 97% | 56% | 40% <sup>4</sup> |

## INTRODUCTION

For the past five years, the Pennsylvania Electric Distribution Companies (EDCs) have been running successful efficiency programs that have exceeded initial savings goals. However, as the 2% cap on spending acts as a limiting factor, the EDCs will need to decide which opportunities to pursue, and how to balance their limited set of financial resources in order to achieve the most benefit for a wide range of market segments. Further, each EDC currently offers a different set of efficiency programs, resulting in uneven access for Pennsylvania residents, potential confusion in the marketplace, likely administrative inefficiencies, and difficulty in comparing results from one utility to the next. This white paper describes some of the existing programs in Pennsylvania, and then goes on to look at the efficiency portfolios in leading jurisdictions. Finally, using the lessons from these jurisdictions, a potential portfolio for Pennsylvania is proposed. It is the hope that this portfolio will expand the energy savings and comprehensiveness achieved by the EDCs into sectors and end uses not currently seeing many savings, and provide a foundation on which to build a sustainable and successful efficiency program.

## EXISTING PENNSYLVANIA PROGRAMS

The seven electric distribution companies (EDCs) in Pennsylvania currently have a fair amount of variation in program offerings. While the four EDCs owned by First Energy offer a standard set of nine programs, these vary significantly from each of the other three EDCs. This paper will take a deeper look at the First Energy and PECO programs. However, the general lessons can also be applied to the other two EDCs.

### First Energy EDCs

The programs offered by the First Energy Companies (Met-Ed, Penelec, Penn Power, and West Penn Power) are as follows.

#### Residential Efficient Products Program

This program offers standard prescriptive incentives for new energy efficient appliances, HVAC equipment, and water heaters. It also contains an upstream lighting program and

<sup>3</sup> From potential study, savings by end use. An additional 13.9% of savings comes from behavioral programs, some of which will come from lighting.

<sup>4</sup> PA Potential Study, Figure 4-4. Commercial only, Lighting is 14.3% of Industrial savings.

consumer electronics component that incepts retailers for energy efficient lighting or electronics sold directly to end users.

### **Residential Home Performance Program**

This program contains multiple components aimed at the residential sector. First, the program has a direct-install component, where a customer will receive an initial home audit including installation of low cost measures as well as recommendations for more cost intensive measures. The PY 5 evaluations found that relatively few customers follow up with these recommendations to install attic insulation, air sealing, or HVAC replacement, and that the vast majority of savings for this component were for the low-cost measures installed during the audit.

The second program component is the home energy reports, in which electricity usage reports are mailed to residential customers. These reports have been found to result in significant savings on an aggregate basis, but with a one year measure life – you need to send the same report to each customer each year in order to maintain a steady level of savings.

In a third component to the program, energy savings kits are mailed to the customer. These kits consist of CFLs, LED night lights, a furnace whistle, a smart power strip, and, if the customer has electric hot water, faucet aerators and low-flow showerheads. For Program Year 5, the program also started providing kits to school children, in conjunction with an energy efficiency educational course with take home work to engage their parents.

Finally, the program contains a new construction component, where the EDCs provide incentives for residential new construction with lower savings than code based on REMRate modeling, or that choose to install efficient shell measures, HVAC systems, lighting, or other features. According to the PY5 evaluation report, this component consisted of a small portion of total program savings.

### **Residential Appliance Turn-in**

In this program, residential customers are incented to recycle old, but working refrigerators and room AC units. Each participant is eligible to receive free pick up and a cash incentive for recycling up to two refrigerators or freezers and two room air conditioners.

### **Residential Low-Income Program**

The low-income program contains multiple components. A direct install component consists of the WARM plus, WARM Extra Measures, and WARM multifamily programs. The differences between these programs are unclear, but they all provide direct install of measures such as CFLs, smart strips, furnace whistles, faucet aerators, LED nightlights, heat pump water heaters, refrigerators, programmable thermostats, and more. A “giveaway” component, gives away CFLs and other low cost measures at community events. Finally, a third program component directly mails energy savings kits to low-income customers.

### **C&I Small Energy Efficient Equipment Program**

This program provides prescriptive and custom incentives for lighting, HVAC, motors and drives, and specialty equipment. It also contains a program providing CFLs and smart strips to

master metered multi-family programs, and an appliance recycling component similar to the Residential Appliance Turn-in Program.

### **C&I Small Energy Efficient Buildings Program**

This program has two components. In the first component, energy conservation kits are directly delivered by mail to commercial customers. The second component incents custom whole building projects such as new construction, retro-commissioning, and building envelope improvements.

### **C&I Large Energy Efficient Equipment Program**

This program is the same as the C&I Small Energy Efficient Equipment Program, but aimed at larger facilities.

### **C&I Large Energy Efficient Buildings Program**

This program is the same as the C&I Small Energy Efficient Buildings Programs, but without the energy conservation kits. This program has not yet had any participants.

### **Government and Institutional Program**

This program works specially with government and non-profits to develop projects through the other program offerings, though it is unclear if there are additional incentive dollars available. Almost all savings in PY5 were from 11 lighting participants (there were two HVAC/DHW projects with negligible savings).

## First Energy Program EDC program quantitative review

The table below shows the program cost per kWh by program of the four First Energy EDCs.

| Program             | Met-Ed         | Penelec        | Penn Power     | West Penn Power |
|---------------------|----------------|----------------|----------------|-----------------|
| Appliance Turn-In   | \$ 0.24        | \$ 0.25        | \$ 0.21        | \$ 0.19         |
| Efficient Products  | \$ 0.10        | \$ 0.09        | \$ 0.09        | \$ 0.10         |
| Home Performance    | \$ 0.14        | \$ 0.16        | \$ 0.17        | \$ 0.12         |
| Low Income          | \$ 0.52        | \$ 0.51        | \$ 0.70        | \$ 1.06         |
| Small Equipment     | \$ 0.15        | \$ 0.13        | \$ 0.18        | \$ 0.20         |
| Small EE Buildings  | \$ 0.61        | \$ 0.40        | \$ 0.56        | \$ 0.39         |
| Large Equipment     | \$ 0.08        | \$ 0.09        | \$ 0.08        | \$ 0.09         |
| Large EE Buildings  |                | \$ 2.68        |                |                 |
| Gov't/Institutional | \$ 0.73        | \$ 0.51        | \$ 2.57        | \$ 0.93         |
| <b>Total</b>        | <b>\$ 0.14</b> | <b>\$ 0.16</b> | <b>\$ 0.16</b> | <b>\$ 0.14</b>  |

As seen, with the exception of a couple of outliers in small programs, costs are largely consist among the four companies. Further, the cost per kWh for the overall portfolio is relatively low compared to some of the programs with higher costs, such as the Energy Efficient buildings program and the low income program. This indicates that savings are driven by the less expensive programs such as Efficient Products, Home Performance and Large Equipment. This is verified by looking at the next table, showing the percent of total savings from each program.

| Program             | Met-Ed      | Penelec     | Penn Power  | West Penn Power |
|---------------------|-------------|-------------|-------------|-----------------|
| Appliance Turn-In   | 3%          | 4%          | 5%          | 5%              |
| Efficient Products  | 27%         | 28%         | 36%         | 29%             |
| Home Performance    | 42%         | 39%         | 36%         | 40%             |
| Low Income          | 3%          | 4%          | 3%          | 1%              |
| Small Equipment     | 10%         | 13%         | 10%         | 10%             |
| Small EE Buildings  | 1%          | 1%          | 1%          | 1%              |
| Large Equipment     | 15%         | 10%         | 10%         | 13%             |
| Large EE Buildings  | 0%          | 0%          | 0%          | 0%              |
| Gov't/Institutional | 0%          | 0%          | 0%          | 0%              |
| <b>Total</b>        | <b>100%</b> | <b>100%</b> | <b>100%</b> | <b>100%</b>     |

The four companies are also remarkably consistent on the distribution of savings among each program. Further, about 70% of total portfolio savings come from the Efficient Products and the Home Performance Programs, with most of the rest coming from the C&I Equipment Programs. This is noteworthy because it is typically less expensive to achieve more savings from the larger customers, as these customers yield vastly more savings per visit. In Massachusetts, for example, almost 60% of total annual 2014 savings and nearly 70% of lifetime



savings came from the C&I sector, with the largest customers making up the majority of those savings. This is an odd contrast with PA, where the largest electric consumers only achieved 10-15% of total savings, and indicates a likely opportunity to achieve better penetration in this important customer segment. The model portfolio below proposes achieving a higher portion of the savings from the C&I sector. We will also recommend several methods of achieving deeper C&I savings, such as using account managers for the largest customers.

Further, the significant amount of low-cost savings achieved in the residential sector indicate that the companies are likely achieving a large portion of the total savings through retail lighting and the direct mailed energy savings kits. A deeper look at the PY5 evaluation reports shows that this is indeed likely the case. For Met-Ed, for example, upstream lighting made up 87% of savings in the efficient products program, and energy conservation kits and low-cost DI measures made up 50% of the Home Performance Program, with another 49% from behavioral changes resulting from the home energy reports. On the C&I side, 95% of the small commercial equipment program savings and 96% of the large commercial equipment program savings came from lighting projects.

## **PECO Portfolio**

PECO Energy ran a total of 19 programs in Program Year 5. This large number of programs partly reflects more disaggregation than the FirstEnergy Companies, with separate “programs” for what are considered program components by FirstEnergy. PECO’s programs are:

### **Smart Appliance Recycling**

This is similar to the First Energy EDCs’ Residential Appliance Turn-in Program, except that it does not seem to give rebates to room ACs – only refrigerators and freezers.

### **Smart Home Rebates**

This program is similar to the FirstEnergy Residential Efficient Products program, with traditional prescriptive rebates for efficient appliances, HVAC equipment, consumer electronics, and fuel-switching measures, as well as upstream incentives for CFL and LED measures.

### **Smart House Call**

This program provides a home audit and direct installation of low-cost measures, as well as follow-up recommendations for more expensive HVAC, building envelope, and water heating measures. It appears very similar to the direct install component of FirstEnergy’s Residential Home Performance Program, except with no direct mail energy kits, and significantly more penetration of non-lighting measures.

### **Smart Builder Rebates**

This program gives rebates to contractors who build ENERGY STAR rated homes. A base rebate of \$450 per home is offered, along with \$0.1 per kWh saved over a baseline home. This program corresponds to the New Construction component of FirstEnergy’s Residential Home Performance Program.

### **Low-Income Energy Efficiency Program**

This program is similar to FirstEnergy's low-income program, but without the direct mail of energy conservation kits. It provides free audits as well as the direct installation of low-cost measures. If more expensive equipment, such as refrigerators, need upgrades, this will also be done. However, shell/weatherization opportunities are limited as most PECO LI customers have gas heat. CFLs represent 88% of the savings from the program.

### **Smart Energy Saver**

This program develops a school curriculum designed to teach school children about energy efficiency, and includes a take home energy conservation kit. It is similar to the education component in FirstEnergy's Residential Home Performance Program.

### **Smart Usage Profile**

This behavioral program uses OPower to send out energy usage reports to residential customers. It is similar to the Home Energy Reports component of FirstEnergy's Home Performance Program.

### **Smart AC Saver**

This is a demand response program, where PECO is able to cycle or shut down a customers' central AC unit on short notice during times of peak demand. This program is mostly about reducing peak demand, and has minimal energy savings.

### **Smart Multi-Family Solutions - Residential**

This program is aimed at both residents and tenants at existing commercial, residential, governmental, institutional, and nonprofit multifamily buildings with four or more living units. The program offers prescriptive incentives to building owners for installing measures such as heat pump water heaters, efficient lighting, and HVAC equipment. A second component, aimed towards residents, offers direct install of CFLs, low-flow showerheads, and faucet aerators. FirstEnergy does not seem to have a direct counterpart to this program.

### **Smart Equipment Incentives – Commercial and Industrial**

This program provides incentives for efficient equipment in the C&I program. In PY5, the program had 329 participants, and 82% of the total savings came from lighting projects. PECO has a stated goal in Phase II of pursuing non-lighting projects. It is similar to First Energy's small and large efficient equipment programs.

### **Smart Equipment Incentives – Governmental, Nonprofit, and Institutional**

This is the same as the above, but for governmental and nonprofit customers. It had 101 participants in PY5, with 82% of the savings from lighting measures.

### **Smart Business Solutions**

This program provides small non-residential customers with the direct installation of lighting, refrigeration, and water heating measures.

### Smart Multi-Family Solutions - Nonresidential

This program is the same as the residential multifamily program. It seems that the difference is if the buildings pay a commercial rate they are counted in this program.

### Smart Construction Incentives

The exact nature of this program is unclear based on the program description in the evaluation report. One component is a new construction program that includes some new whole building projects that used building modeling. The other component less clear, but seems like a prescriptive new construction tract.

### Smart On-Site

This program provides incentives for CHP installations. Two projects were installed in 2015, for a total capacity of 7.4 MW.

### Smart AC Saver- Commercial

This is an AC cycling demand response program for the commercial sector. It is similar to the Smart AC Saver program for the residential sector.

## PECO Program discussion

The table below shows the cost per annual kWh saved for each of PECO's programs, as well as the amount of savings it contributed, as a percent of the total portfolio savings.

|  | \$/kWh         | % of savings |
|--|----------------|--------------|
| Smart Appliance Recycling                  | \$ 0.14        | 2%           |
| Smart Home Rebates                         | \$ 0.09        | 44%          |
| Smart House Call                           | \$ 2.03        | 0%           |
| Smart Builder Rebates                      | \$ 40.00       | 0%           |
| Smart Energy Saver                         | \$ 0.22        | 1%           |
| Smart Usage Profile                        | \$ 0.20        | 1%           |
| Smart Multi-Family Solutions - Residential | \$ 0.42        | 1%           |
| Low-Income Energy Efficiency               | \$ 0.36        | 6%           |
| Smart Equipment Incentives                 | \$ 0.25        | 15%          |
| Smart Construction Incentives              | \$ 0.27        | 2%           |
| Smart Business Solutions                   | \$ 0.18        | 4%           |
| Smart On-Site                              | \$ 0.09        | 22%          |
| Smart Multi-Family Solutions - Commercial  | \$ 0.30        | 1%           |
| <b>Total</b>                               | <b>\$ 0.15</b> | <b>100%</b>  |

Looking at this table, a few things jump out:

- The cost to achieve of \$0.15 per kWh is quite cheap compared to the cost per annual kWh in other jurisdictions, and in line with the other EDCs

- The two CHP projects produced a very large amount of savings, contributing 22% to the portfolio savings.
- This CHP program was very inexpensive, contributing significantly to the low overall portfolio costs
- Excluding CHP, the commercial sector only achieved 28% of total portfolio savings. This is in line with the FirstEnergy EDCs, but low compared to other jurisdictions.
- Savings from the Smart Usage Profile for PECO are much lower than they are for the FirstEnergy EDCs, where they were about 50% of the savings from the Home Performance Program, which in turn was 40% of the total portfolio savings. This equates to about 20% of total portfolio savings from Home Energy Reports for First Energy, compared to 1% for PECO. This is most likely a function of lower participation rates for PECO.
- PECO seems to have one a somewhat better job pursuing non-lighting projects than the FirstEnergy EDCs.

## ELEMENTS OF A COMPREHENSIVE PORTFOLIO

This section examines the essential elements of a good efficiency portfolio, as informed through an investigation of portfolios of leading jurisdictions in Rhode Island, Massachusetts, California, and Vermont.

### Good Balance Between Sectors

A well constructed portfolio has programs targeting opportunities in all market sectors, and specifically pursues important but hard-to-reach market segments such as low-income households and small businesses. The table below shows annual savings sector as a percent of total portfolio savings in California, Massachusetts, Vermont, and Rhode Island. The California distribution is shown both with and without the significant contribution from codes and standards.<sup>5</sup>

|                            | MA  | RI  | VT  | PGE | PGE no codes and standards |
|----------------------------|-----|-----|-----|-----|----------------------------|
| Residential and Low-income | 43% | 37% | 41% | 20% | 31%                        |
| Commercial and Industrial  | 57% | 63% | 59% | 44% | 69%                        |
| Codes and Standards        |     |     |     | 36% |                            |

<sup>5</sup> PG&E monthly report, January 2015. Savings from agriculture are included under industrial. Savings from separate lighting program are distributed between C&I and res.

As seen, most jurisdictions are getting around 40% of savings from the Residential sector and 60% from the Commercial sector. PG&E gets a slightly higher portion of its savings from C&I, though this is mainly do to significant agricultural savings. This table shows annual savings – if you look at lifetime numbers, the savings skew even more toward commercial, due to a large amount of short lived residential behavioral savings, as well as a preponderance of lighting fixture replacements in C&I compared to screw-in bulbs in residential.

Pennsylvania gets a significantly larger portion of its savings from residential programs. The table below shows savings by sector by state. As seen, Pennsylvania gets about 65% of its savings from residential (including low income), and the other 35% from C&I. This is inconsistent with the savings distribution from many other utilities, as well as the distribution of electric sales in PA, which consist of about 63% C&I and 37% residential. This skew suggests there is likely opportunity in Pennsylvania for higher savings in the commercial and industrial sector. However, as mentioned earlier, due to lower costs in the C&I sector, the percentage of utility revenue coming from residential versus C&I is roughly even. State specific requirements for sector equity may limit the

|                  | Res        | Low Income | C&I        |
|------------------|------------|------------|------------|
| Duquesne Light   | 45%        | 11%        | 43%        |
| Met-Ed           | 72%        | 3%         | 25%        |
| Penelec          | 71%        | 4%         | 25%        |
| Penn Power       | 76%        | 3%         | 20%        |
| West Penn Power  | 74%        | 1%         | 24%        |
| PECO             | 51%        | 6%         | 43%        |
| PPL              | 55%        | 1%         | 43%        |
| <b>Statewide</b> | <b>60%</b> | <b>4%</b>  | <b>35%</b> |

### Greater Focus on Lifetime Savings

It is important for energy efficiency programs to go beyond the simple and low cost measures such as lighting and behavioral measures. When the very attractive measures are cherry picked and done on their own, it may create lost opportunities where the more complex measures are less likely to be implemented. By contrast, if a program takes a holistic approach at energy savings for a customer, the less expensive measures help make the whole project look more financially attractive. Further, many times the more complex and expensive measures have a longer measure life than the low cost measures. This means that even though they look expensive on a \$/annual kWh, they will look much more attractive on a \$/lifetime kWh basis.

Residential behavioral programs provide a good illustration of this effect as noted in the table. Notice that on an annual basis, the behavioral program at \$0.07/kwh looks like the cheapest program in Massachusetts’s 2014 portfolio. However, on a lifetime basis, it becomes more expensive than any other non low-income program with the exception of Home Energy Services, although this is explained in part because the program supports significant oil savings. Note that, although Massachusetts and most other states use a one year measure life for

behavioral programs, there is recent evaluation data that indicates that savings may actually persist for multiple years, which would make behavior programs more cost effective when compared on a lifetime basis. For example, a 2014 report by Cadmus finds annual savings decay after the behavioral program is stopped of 20%<sup>6</sup>. This means savings from behavioral programs are likely to have a multiple year measure life, however it also means that the incremental annual savings from multiple years of behavioral programs will decline. To address these findings, we recommend that Pennsylvania strongly consider updating the custom measure protocol for behavior programs to account for longer measure life. Further, there is some good evidence that participation in behavioral programs raises general awareness of efficiency and thus increases participation in other programs with longer measure lives.

Despite the above caveats, this illustrates at the importance of considering lifetime savings in addition to annual savings – the lifetime savings tend to give a more complete picture of the benefits of the portfolio, and an emphasis on lifetime savings encourages more complex measures to be implemented.

|                                    | \$/annual kWh | \$/lifetime kWh | Implied Measure Life |
|------------------------------------|---------------|-----------------|----------------------|
| <b>Total</b>                       | <b>\$0.36</b> | <b>\$0.04</b>   | 9                    |
| <b>Residential</b>                 | <b>\$0.36</b> | <b>\$0.05</b>   | 7                    |
| Residential Consumer Products      | \$0.57        | \$0.07          | 8                    |
| Residential Cooling & Heating      |               |                 |                      |
| Equipment                          | \$0.96        | \$0.07          | 14                   |
| Residential Lighting               | \$0.15        | \$0.02          | 8                    |
| Residential Behavior/Feedback      | \$0.08        | \$0.08          | 1                    |
| Residential Home Energy            |               |                 |                      |
| Services                           | \$1.06        | \$0.12          | 9                    |
| Residential Multi-Family           |               |                 |                      |
| Retrofit                           | \$0.87        | \$0.08          | 11                   |
| Residential New Construction       | \$0.64        | \$0.06          | 11                   |
| <b>Low-Income</b>                  | <b>\$1.29</b> | <b>\$0.13</b>   | 10                   |
| Low-Income Multi-Family            |               |                 |                      |
| Retrofit                           | \$1.03        | \$0.10          | 10                   |
| Low-Income New Construction        | \$1.99        | \$0.19          | 10                   |
| Low-Income Single Family           |               |                 |                      |
| Retrofit                           | \$1.79        | \$0.19          | 9                    |
| <b>Commercial &amp; Industrial</b> | <b>\$0.31</b> | <b>\$0.03</b>   | 10                   |
| C&I New Construction               | \$0.22        | \$0.02          | 11                   |
| C&I Direct Install                 | \$0.73        | \$0.06          | 12                   |
| C&I Retrofit                       | \$0.29        | \$0.02          | 15                   |

<sup>6</sup> Khawaja, M. Sami and Stewart, James. *Long Run Savings and Cost-Effectiveness of Home Energy Report Programs*. Winter 2014/2015.

## Variety of End-Uses

Newer efficiency programs typically get the vast majority of their savings from lighting measures. As they mature, programs tend to expand more into other end uses, in order to ensure sustainably high levels of savings and to avoid creating lost opportunities. The table below shows the portion of savings attributable to lighting in Vermont, California, and NStar<sup>7</sup> (Massachusetts).

|            | Vermont | California <sup>8</sup> | NStar (MA) |
|------------|---------|-------------------------|------------|
| % lighting | 61%     | 43%                     | 56%        |

This 40% - 60% range is about what can be expected from established highly performed programs. Some other jurisdictions see a much higher percentage of projects from lighting. Met Ed, for example, got 71% of annual savings from lighting, with another 21% from residential behavioral programs. This leaves only 8% for larger more in-depth projects.

## Combined Heat and Power

Combined Heat and Power (CHP) is an on-site installation electric generator whose waste heat can be used to satisfy thermal load. Because these units integrate the production of electric and thermal energy, they are significantly more efficient than producing each separately. CHP systems are most effective in industrial or large commercial applications with a year round thermal load to take maximum advantage of the waste heat produced by the CHP system. Many top performing utilities have significant contribution from CHP systems – 10% of NStar MA’s 2013 savings, for example, came from CHP. Some Pennsylvania EDCs already have thriving CHP programs – PECO achieved 22% of total program savings from CHP - and there is opportunity to carry this success to the other EDCs in the state.

## Codes and Standards

Recently, more energy efficiency program administrators have begun including a codes and standards programs as part of their portfolio. As discussed earlier, Pacific Gas and Electric achieved 36% of its 2013-2014 savings from its codes and standards program, and RI is planning on ramping up a program to achieve 6% of the commercial goal and 2% of the residential goal. Getting codes and standards savings at the level of California requires that the state actively pursue state standards and codes upgrades. Rhode Island’s savings are much lower than those in CA, because it is focusing its programs around increasing code compliance.

There are three main ways in which codes and standards programs can capture savings. These are:

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<sup>7</sup> Now part of Eversource

<sup>8</sup> Not including Codes and Standards



- Provide training and funding for code compliance officials and builders to improve the rates of code compliance in the jurisdiction
- Work with local governments to adopt stretch codes that are more stringent than the statewide energy code
- Work with code setting and/or appliance standards entities to directly influence appliance standards and/or building codes.

It is probably easiest for new programs to focus on improving code compliance, as it possible to show that utility efforts have had a direct impact on compliance rates via studies. For example, a baseline study in Rhode Island found that commercial buildings completed in 2008-2011 were only 70% compliant with existing code. In other words, the buildings were using 30% more energy than they would if they fully complied with state code. Increasing code compliance thus offers significant opportunity for increased energy savings, and Rhode Island is implementing four strategies to do so:

- **Trainings:** Rhode Island will develop a curriculum of on-site, classroom, and web-based trainings for appropriate third party vendors. Separate raining sessions will target the building envelope, HVAC, and electrical sections of the code, as well as code compliance software.
- **Technical Assistance.** Rhode Island will hire energy code and efficient design consultants, known as circuit riders, to act as an intermediary between design/builders and energy code officials. The circuit riders will clarify any misunderstandings or confusion that market actors may have about existing energy code, and support their efforts to build code compliant buildings.
- **Support for Third Party Inspections:** Rhode Island law allows for voluntary third-party inspections of the building energy code for residential and commercial new construction. As part of this provision, the Rhode Island program administrator will develop trainings for technical and administrative topics for any vendor who wants to become a third-party
- **Documentation Tools:** Rhode Island will develop a consistent set of documentation tools such as builder manuals, software tools, checklists, and code check protocols. This set of tools will reduce the significant confusion in the construction industry regarding the acceptable level and formatting of documentation is support of code compliance.

The Rhode Island program started slowly in 2013, with the program getting 0.7% of the commercial savings and 0.2% of the 2013 residential goal. However, they are planning to continue ramping up program efforts until reaching a target of 90% compliance by 2016. At this time, 40% of the savings from the increase in compliance will be attributed to the program. This equates to about 6% of the commercial goal and 2% of the residential goal.



## Small Business Direct Install

Small businesses face particularly strong market barriers preventing investment in energy efficiency. In the face of these barriers, efficiency programs have found that, in order to secure significant participation, it is necessary to give higher incentives and minimize the time commitment needed from small business owners or employees. To this end, small business direct install programs have become popular. These programs provide up to 75% of the full installed cost of the direct installation of lighting, hot water, and other relatively easy to install measures. The program also covers the initial cost of the audit at the commercial facility.

Although some Pennsylvania EDCs, such as PECO, already offer a small business direct install program, it is not consistently offered throughout the state. We believe that it would be highly beneficial for Pennsylvania small businesses served by every EDC to have access so a small business direct install program.

## MODEL PORTFOLIO

### Portfolio

A good portfolio reaches all customer segments with comprehensive programs that encourage customers to go beyond the simplest measures. The next two tables below show a model ideal portfolio for Pennsylvania, drawn from the experiences described above in Massachusetts, Vermont, Rhode Island, California, and other jurisdictions with nation leading efficiency portfolios. There are a few important things to note in the tables:

- The cost per annual kWh of the portfolio is \$0.24. This is higher than the statewide cost per kWh achieved in Phase II PY 5 of \$0.14 and the acquisition cost in the commission order of \$0.184. This is a result of the proposed portfolio containing a more balanced mix of measures and higher contribution from the commercial sector, with less cherry picking of low cost measures, and higher lifetime savings. However, it is important that, if Pennsylvania were to adopt the proposed portfolio below, significant effort be taken to diversify beyond lighting and behavioral efforts.
- Note that, although the portfolio needs to offer more than lighting and behavioral programs, these are still very important elements of the portfolio. There is evidence, for example, that behavioral programs may actually have a longer than one year measure life, and that they increase participation in other programs. This is seen in the portfolio, where 11% of total savings is achieved through behavioral programs, more than currently achieved by some EDCs.
- The cost per kWh is based on actual Pennsylvania performance, rather than the potential study. This is so we can ensure that the EDCs can realistically achieve the savings with the desired mix of programs. A cost of \$0.24 per kWh can realistically be achieved with well-designed comprehensive programs that do not resort to cherry picking or to measures with high likely net-to-gross ratios.

- In addition to energy savings, the portfolio produces a peak demand reduction of 160 MW. This reduction is higher than what would be produced by equivalent energy savings from Pennsylvania's current portfolio, since HVAC measures have a greater portion of energy use occur during peak hours.
- The total annual portfolio cost to the EDCs is approximately \$210 million, compared with the average annual cost of the proposed Phase III program of approximately \$225 million. This is mainly due to the DR carveout assumed in the analysis for the model portfolio.
- The portfolio assumes \$500,000 will be spent on codes and standards, with no associated savings in the first year. This is because it takes multiple years for codes and standards efforts to begin yielding savings. Further, there are issues on how to attribute savings to the utility and screen for cost effectiveness before savings can be estimated. This model will have to be accepted by the regulators before moving forwards. However, if the EDCs and the necessary stakeholders commit to a codes and standards program, significant low cost savings can be expected in future years.
- The cost per kWh of behavioral programs is \$0.07. This is taken from other states that have more wider participation than Pennsylvania. In Pennsylvania, the current programs are more highly targeted at higher energy usage, and so achieve a cost closer to \$0.04/kWh.
- None of the programs relies on mail-in energy savings kits with CFLs and aerators, especially in the commercial sector. Pennsylvania programs should start to move away from mail-in CFLs as a means of generating savings.

|                    | Spending<br>(thousand \$) | Annual Savings<br>(MWh) | Lifetime<br>Savings (MWh) | Peak              |                  |
|--------------------|---------------------------|-------------------------|---------------------------|-------------------|------------------|
|                    |                           |                         |                           | Reduction<br>(MW) | \$/annual<br>kWh |
| ion                | 11,044                    | 8,885                   | 126,929                   | 3                 | 1.24             |
| ervices            | 50,029                    | 53,308                  | 644,975                   | 7                 | 0.94             |
| les upstream)      | 7,262                     | 97,732                  | 97,732                    | 12                | 0.07             |
|                    | 10,674                    | 115,501                 | 1,071,866                 | 15                | 0.09             |
| ighting or HVAC)   | 6,399                     | 26,654                  | 363,906                   | 5                 | 0.24             |
|                    | 10,665                    | 53,308                  | 434,913                   | 9                 | 0.20             |
|                    | <b>96,072</b>             | <b>355,389</b>          | <b>2,740,321</b>          | <b>52</b>         | <b>0.27</b>      |
|                    | <b>10,938</b>             | <b>26,654</b>           | <b>257,189</b>            | <b>4</b>          | <b>0.41</b>      |
| ion - Lighting     | 15,566                    | 79,963                  | 861,269                   | 14                | 0.19             |
| ion - Non Lighting | 15,506                    | 62,193                  | 848,191                   | 16                | 0.25             |
| - Lighting         | 27,563                    | 115,501                 | 1,431,378                 | 20                | 0.24             |
| - Non Lighting     | 29,318                    | 142,156                 | 1,675,927                 | 36                | 0.21             |
|                    | 11,585                    | 62,193                  | 741,672                   | 11                | 0.19             |
|                    | 3,896                     | 44,424                  | 645,696                   | 7                 | 0.09             |
|                    | <b>103,433</b>            | <b>506,429</b>          | <b>6,204,133</b>          | <b>104</b>        | <b>0.20</b>      |
|                    | <b>210,443</b>            | <b>888,472</b>          | <b>9,201,643</b>          | <b>160</b>        | <b>0.24</b>      |
|                    | 500                       |                         |                           |                   |                  |
|                    | <b>210,943</b>            | <b>888,472</b>          | <b>9,201,643</b>          | <b>160</b>        | <b>0.24</b>      |

## Comparison with Current Portfolio

The table below compares some key metrics of the model portfolio with the statewide PY 5 programs and the goals set forth in the recent commission order. There are a few important things to note in the comparison:

- The PY5 portfolio and the Commission order both have about 60% of savings coming from the residential sector and 40% coming from the C&I sector. The model portfolio reverses this ratios, with 40% coming from residential and 60% from C&I. We believe that this split better reflects the long term savings opportunity and sales distribution of Pennsylvania customers.
- For the model portfolio we present estimated lifetime energy savings. A comparable value for the PY5 portfolio or the commission order are not available. However, we do estimate the approximate lifetime savings from the current PY 05 portfolio. Note that even though the PY5 portfolio produces more annual savings, it gets lower savings on a lifetime basis. However, this is a high level estimate, and actual lifetime savings from the PY5 portfolio could vary. To reduce this uncertainty, we recommend that this important metric should be reported going forward. Reporting lifetime savings would give a more holistic view of the portfolio, and help create a portfolio that better correlates with economic benefits.
- The lifetime for some programs in the model portfolio is lower than typical, due to the requirement in Pennsylvania that no measure have a lifetime of greater than 15 years. Without this requirement, the lifetime savings would be even higher.
- The last row of the table looks at the percent of total prescriptive residential and C&I program savings coming from lighting. The data in the table reflect PPL's PY5 programs (rather than statewide values), they are fairly representative for overall EDC performance. Note that there is a significant decrease in the percent of savings coming from lighting in the model portfolio – from 97% to under 60%.
- The cost per annual kWh is higher in the model portfolio than it is in either the PY5 results or the commission order. We believe that this is a reasonable trade-off in exchange for better programs that reach more customers with a much wider variety of efficiency measures. Further, due to a longer average measure life in the model portfolio, this difference will be strongly diminished if looked at on a \$/lifetime kWh basis.

|   | Comparison   | PA PY 05         | Model Portfolio  | Commission Order |
|---|--------------|------------------|------------------|------------------|
| Percent of total savings                            | Residential  | 60%              | 40%              | 59%              |
|   | Low Income   | 4%               | 3%               | 6%               |
|   | C&I          | 35%              | 57%              | 35%              |
| \$/annual kWh                                       | Residential  | \$ 0.12          | \$ 0.27          | n/a              |
|   | Low Income   | \$ 0.42          | \$ 0.41          | n/a              |
|   | C&I          | \$ 0.15          | \$ 0.20          | n/a              |
|   | <b>Total</b> | <b>\$ 0.14</b>   | <b>\$ 0.24</b>   | <b>\$ 0.184</b>  |
| Total Annual Savings (MWh)                          | Residential  | 569,264          | 355,389          | 721,543          |
|   | Low Income   | 43,704           | 26,654           | 67,362           |
|   | C&I          | 390,132          | 506,429          | 435,863          |
|   | <b>Total</b> | <b>1,003,100</b> | <b>888,472</b>   | <b>1,224,768</b> |
| Total Lifetime Savings (MWh)                        | Residential  | 3,761,850        | 2,740,321        | n/a              |
|   | Low Income   | 453,524          | 257,189          | n/a              |
|   | C&I          | 4,069,869        | 6,204,133        | n/a              |
|   | <b>Total</b> | <b>8,285,243</b> | <b>9,201,643</b> | n/a              |
| Percent of prescriptive program from lighting (PPL) | Residential  | 97%              | 59%              | 36%              |
|   | C&I          | 97%              | 56%              | 40%              |

## Model Portfolio Program Descriptions

### Residential New Construction

The Residential New Construction (RNC) Program aims to encourage new buildings to exceed the applicable state energy code. A well designed RNC program will provide both prescriptive pathways, which offer deemed incentives for a package of pre-defined measures covering a variety of end uses, and a performance pathway, which requires that the home achieve energy savings versus code. Ideally, the incentive structure is set up so there is more money available the higher the improvement over code. Also, the program should require that builders install ENERGY STAR rated LEDs in all hard wired sockets. As seen in the proposed portfolio, the RNC program has a significantly higher cost per annual kWh than the portfolio as a whole. This is acceptable because an efficiently built home will continue to generate savings for many years into the future, and significant lost opportunities are created when a home is not constructed efficiently. Significant non-electric fuel savings from envelope, HVAC and DHW measures and non-energy benefits are created due to the efficient construction.

## **Residential Home Energy Services**

The Home Energy Services (HES) Program provides home audits that give the home owner general knowledge about efficiency, identify energy savings opportunities and directly install CFLs and LEDs, aerators, low-flow showerheads, and programmable thermostats. The savings from these direct install measures, on average, should offset the expected cost of the visit. The auditor may schedule follow up visits for air sealing, insulation, HVAC maintenance/replacement, or other needed efficiency measures or, potentially, offer air and duct sealing during the initial visit. Due to the comprehensive nature of the program, as well as the fact that some of the money is spent on measures largely impacting heating fuel savings, costs are also higher for this program than for the overall portfolio. This is acceptable, as long as significant effort is made to go beyond the low-cost measures and achieve significant penetration in envelope and HVAC measures.

## **Residential Behavioral Program**

Residential Behavioral Programs can take many specific forms, but typically involve sending homes a regular monthly energy report, either hard copy or via email, with information on their energy usage, a comparison with the neighbor's usage, and ideas for reducing the energy usage. Evaluation reports have shown that these reports lead to a small per home reduction in energy usage which, when spread across many homes, causes a significant reduction in energy usage. However, the program has a short measure life, and so looks much more expensive on a lifetime basis than on an annual basis. That said, there is evidence that behavioral programs play an important role in driving participation in other programs.

## **Residential Lighting**

This program provides incentives for residential lighting products. Ideally, it will achieve significant market penetration through upstream incentives, but also provide for an online catalog channel, and more traditional mail-in rebates, but primarily for those retailers unable to participate in an upstream program. Due to changes in the lighting baseline caused by EISA, and the resulting uncertainty in the marketplace, residential lighting programs face challenges in the near future. Early indications show that halogen incandescents are gaining significant traction in the market as a replacement for traditional incandescents, and so there are still large opportunities for standard CFLs. Nevertheless, the residential lighting program should begin to shift away from promoting standard CFLs and towards LEDs in the coming years. LED performance characteristics exceed those of CFLs in nearly all categories including, but not limited to, lifetime, efficacy, run-up time, cold temperature performance, and dimming. On a \$/lifetime kWh basis specialty LEDs are already as cost efficient as specialty CFLs.

## **Residential HVAC**

The residential HVAC program gives prescriptive rebates for energy efficient HVAC and DHW equipment, as well as for quality installation verification (QIV). Some jurisdictions have begun offering an upstream program for HVAC and DHW, which has seen some success in achieving much higher market penetration than traditional prescriptive incentives. Home energy management systems are another possible addition to this program, as the technology continues to rapidly advance. Ideally, a residential HVAC program will also give incentives for

services related to the proper functioning of HVAC equipment. These services may include quality installation verification (QIV), duct sealing, and equipment downsizing. In conjunction with this, the program will need to provide QIV training, to ensure that there are sufficient qualified contractors in the area.

### **Residential Products**

This program provides rebates for products not included in the lighting or HVAC programs, such as advanced power strips, consumer electronics, refrigerators, and room air conditioners. It also contains an appliance recycling component similar to what is already being offered in Pennsylvania. Although incentives are typically structured as downstream mail-in or point of purchase rebates, leading jurisdictions have begun experimenting with mid- and upstream models. Further, many ENERGY STAR appliances and electronics already have significant market share. The program administrator should stay aware of the market share of the rebated products, and, if necessary, increase the minimum performance required for a rebate to a ENERGY STAR's Most Efficient specification, or a higher CEE tier.

### **Low-Income**

The low-income program is similar to the home energy services program, except that all measures are installed at no cost to the customer. Because this program pays the full cost installed cost on a comprehensive set of measures, and because low-income customers are typically harder to reach, low income programs typically have the highest program costs per kWh of any in the portfolio, and often do not pass the standard cost-effectiveness tests unless co-implemented with other fuel providers or if non-energy benefits are included in the cost-effectiveness tests, WAP providers and/or non-resource benefits are included in the cost-effectiveness calculation. This is typically deemed acceptable, as low-income programs also achieve widely accepted non-energy benefits.

### **Commercial New Construction**

This program has two main components. First, there is an upstream lighting component for commercial lighting. This is similar in structure to the residential upstream lighting program, but focuses on commercial lighting fixtures, such as linear fixtures, troffers, downlights, and high bays. The second component provides technical assistance and prescriptive or custom incentives for efficient new construction and major renovation. It is highly encouraged for the program administrator to achieve non-lighting savings in this program. For this reason, lighting and non-lighting savings are shown separately above. Note that some Pennsylvania EDCs have separate programs for institutional and industrial customers. In this portfolio, both would fall under the “commercial” umbrella.

### **Large Commercial Retrofit**

This program provides technical assistance and financial incentives to existing large commercial and industrial customers to reduce the energy use in their facilities. This program will ideally include specialized technical assistance by commercial and industrial sector, especially for key market segments such as wastewater treatment facilities, hospitals, and important industrial segments. Further, successful programs typically employ account managers who foster long-term one on one relationships with the largest energy users in their



jurisdiction. These account managers get to know the key customer's budget cycle, investment criteria, and key barriers, and work with each customer to structure projects and incentives that make sense for both parties. Other jurisdictions have seen significant success with account managers, and it is typical that these relationships generate projects with significant savings year after year.

### **Small Direct Install**

The Small Direct Install (SBDI) program was described above, and includes a free audit alongside incentives for the direct installation of easy-to-install measures. Higher incentive portions and a hard to reach customer segment mean that the cost per kWh tends to be higher than other C&I programs. However, it is still an important way to ensure that small business customers share in the benefits of energy efficiency. As noted earlier, some but not all Pennsylvania EDCs already offer a similar program.

### **Combined Heat and Power**

This program is also discussed earlier. Projects are often very large, and one or two CHP projects can contribute to a significant portion of savings in a portfolio. As a result, savings from CHP tend to be lumpy from year to year, depending on when large projects happen to finish. The numbers in the table above represent a reasonable average target for CHP installations.

## **CONCLUSION**

This portfolio contains programs and program components designed to go beyond lighting and easy to install measures in order to achieve deeper savings in a variety of market segments. As a result, the cost per kWh is somewhat higher than the current programs in Pennsylvania, and the portfolio will achieve lower annual savings. However, we believe that this is an acceptable tradeoff in order to ensure that comprehensiveness is achieved, all market segments are reached, and lost opportunities are avoided. Further, creating consistent programs across the EDCs will reduce confusion in the market place when one contractor has to work with multiple EDCs, facilitate communication across EDCs, and increase the reporting transparency. We believe that the portfolio above, or a similar portfolio, will help Pennsylvania forge a leading role in efficiency, and establish a sustainable regime that continues to create significant benefits for Pennsylvania residents.