

Memo



→ CONSULTANT TEAM

To: **Energy Efficiency Advisory Council**
From: **EEAC Consultant Team**
Date: **August 14, 2015**
Subject: **2016-2018 Planning Assumptions for Key Drivers Update**

SUMMARY

Over the past few months, the PAs and the Consultant Team have undergone a process to see if the significant savings and cost gaps between the PA draft plan and Consultant Team goal estimates could be narrowed or closed. Discussions have been helpful in allowing parties to understand positions and work toward common understandings. In many cases, the differences between the PAs' and the Consultant Team's positions are based on assumptions and forecasts about the future, which necessarily carries some unknowns and requires the exercise of judgment. There are simply not exact levels of the future volume or mix of strategies/measures that can be predicted with complete certainty. In other cases, the discussions and analysis have resulted in a narrowing of the differences between the Consultant's and PA's assumptions related to costs and savings. On the cost side of the key driver process, the costs of savings are influenced to some extent by the volume and mix of program strategies, measures, and services. Some of these factors need to be looked at in an iterative fashion with the savings in order to assign a value—in many cases more and deeper savings result in higher costs. If savings fall or the measure mix tends more toward lighting, the case for higher costs to achieve is weaker.

Having reviewed many of the PAs' important assumptions and understanding how they differ from our own, the Consultants have made adjustments to our estimates of the achievable level of portfolio savings (% of sales). These adjustments resulted in final savings recommendations of 3.01% of sales for electric and 1.43% for gas. The Consultant Team concluded that these savings can be achieved at an annual cost of \$.418/kWh and \$.6.775/therm. These recommendations are further described later in this memo. The current result of these adjustments reflects savings goals similar to those originally proposed by the Consultants. While the PAs have discussed changes to their projections in several key areas, we have not yet received a formal position change in any of the key driver categories. As a result, the tables below summarize revisions to the original Consultant Team savings projections, but do not reflect changes in the PAs' projections. Closing the remaining gap will need to move to the negotiation process that is currently underway and will no longer be about analysis of the key drivers. We understand this negotiation will be supported by the Consultants but will take place between the Council and the PAs. We will continue to stay actively engaged in providing up-to-date information from our continued discussions with the PAs.

BACKGROUND

In April, the Consultant Team completed an analysis to identify available pools of untapped energy savings in Massachusetts. This analysis was informed by historical and projected Massachusetts data, the assessment of potential completed in March, as well as professional judgment drawn from experience in the Commonwealth and in other jurisdictions. Based on the additional savings identified, the Consultant Team recommended savings goals for 2016-2018.

After reviewing the PAs' April 30 Three-Year Plan draft, it was clear that some of the planning assumptions made by the PAs were not consistent with those made by the Consultant Team. The PAs' 2016-2018 goals and associated savings were generally lower than those proposed by the Consultants while the budgets were higher. Over the past couple months, the Consultant team has been working and coordinating with the PAs to identify

and explore the main assumptions that account for differences in the proposed goals and budgets put forward by the PAs and those by the Consultants in a process called the “key drivers analysis.” This has been a collaborative process between the EEAC Consultant team and the PAs with input from other stakeholders. Additionally, the Consultant team updated its analysis to reflect 2014 Plan Year Report evaluated data that the PAs filed in June, rather than the preliminary 2014 results provided in the 2014 4th Quarter Report. The sections below identify several key assumptions originally made by the Consultants, any changes to these assumptions from additional review, as well as an explanation of the impact those changes may have on the proposed goals. While most of our initial work focused on analyzing savings assumptions, the Consultant Team has conducted a closer review of the cost and budget assumptions in recent weeks. However, many of the program strategy recommendations included in the Council resolution, but not currently included in the Draft Plan, could have a significant effect on the budgets and costs to achieve, since the Plan’s portfolio cost is a result of which customers are included and the measures and services available to them. Work on budgets and costs to achieve will be largely completed in time for the August Council meeting.

PORTFOLIO SAVINGS SUMMARY

Savings

The tables below present the impact of revised residential, low income, and C&I assumptions on the portfolio savings goals to date. The tables also show the Consultant Team’s original recommendations, as well as interim recommendations presented on August 4. Although these values have been revised and refined as the Consultant Team worked through the key drivers analysis process, a gap still remains between the Consultant Team proposed goals and the PA plan presented on April 30.

Table 1. Consultant Team Portfolio Electric Savings Goals

Year	Annual Savings as a % of Sales (Original 4/23)	Annual Savings as a % of Sales (Revised 8/4)	Annual Savings as a % of Sales (Revised 8/12)
2016	2.98%	2.81%	2.83%
2017	3.03%	2.99%	3.02%
2018	3.09%	3.14%	3.19%
2016-2018	3.04%	2.98%	3.01%

Table 2. Consultant Team Portfolio Gas Savings Goals

Year	Annual Savings as a % of Sales (Original 4/23)	Annual Savings as a % of Sales (Revised 8/4)	Annual Savings as a % of Sales (Revised 8/12)
2016	1.38%	1.35%	1.35%
2017	1.47%	1.45%	1.45%
2018	1.54%	1.49%	1.49%
2016-2018	1.47%	1.43%	1.43%

Savings Gap from Key Drivers Analysis to Date

The table and figures below identify the difference in savings that remains between the PAs’ 2016-2018 April draft plan and the Consultant Team’s revised assumptions. It is important to recognize that not all savings assumptions were reviewed. Therefore, the key drivers process would not necessarily close the savings gap even if both parties agree to the same values for the key drivers.

Table 3. Savings Gap from Key Drivers

Driver	Difference (GWh)	% of Total GWh Difference*	Difference (Million Therms)	% of Total Therm Difference*
Residential Lighting	194	27%		
Behavior Programs	109	15%	7.0	29%
Home Energy Services (Gas)		0%	4.0	17%
CHP	135	19%		
Commercial Lighting	190	27%		
Streetlighting	53	1%		
Mid size and Small Business Customers	74	10%	0.5	2%
Total	874	106%	11.5	47%

*Percentages based on total remaining differences (714 GWh or 24 million therms as denominator). The original savings gap was 750 GWh and 26 million therms.

Figure 1. Remaining Electric Savings Gap

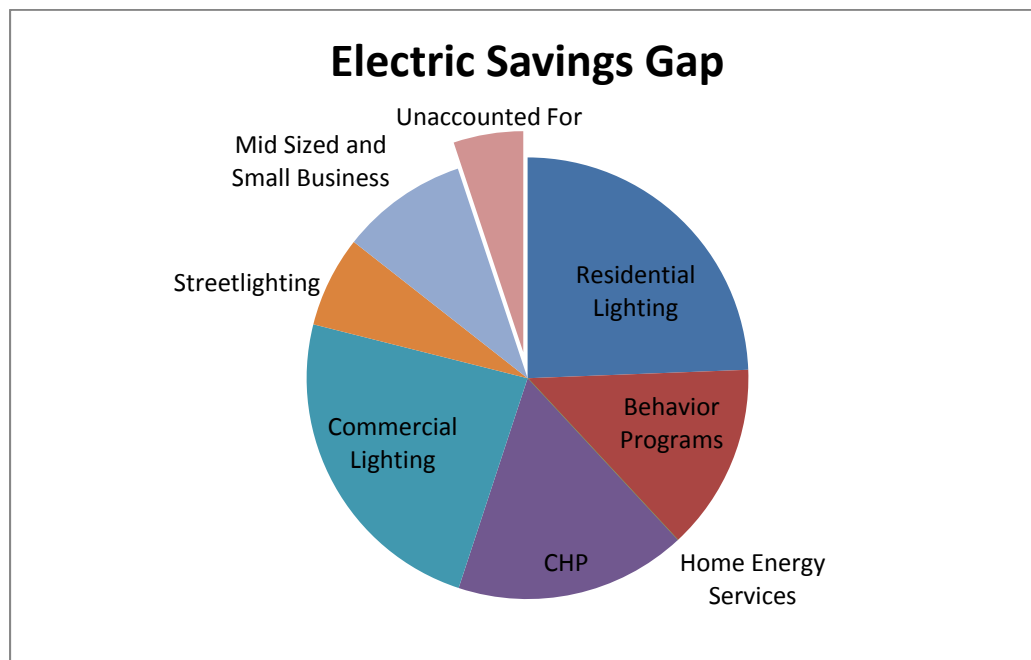
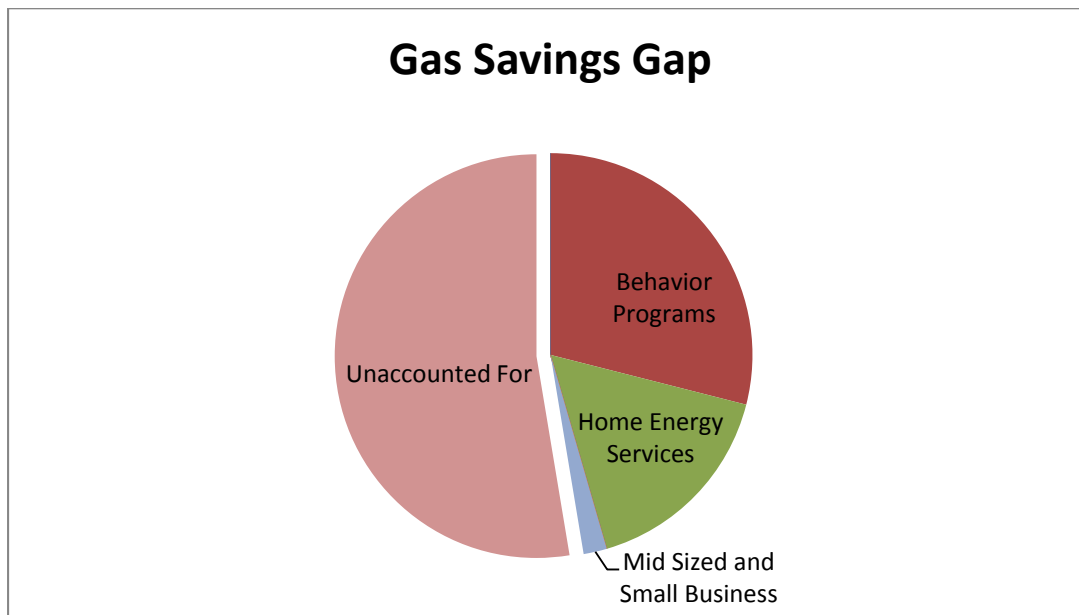


Figure 2. Remaining Gas Savings Gap



PORTFOLIO COST SUMMARY

Costs to Achieve

As previously mentioned, the key drivers process initially focused on differences in saving. Additional analysis has also been done to address differences between the PA and Consultant Team’s assumed costs to achieve. The table below identifies the difference in the PA and Consultant Team’s assumed costs to achieve following a closer review of cost assumptions. Overall, The PAs assumed higher costs to achieve than the Consultant Team.

Table 4. Portfolio Cost to Achieve 2016-2018

	PA Program Budget (\$Millions)	Consultant Program Budget (\$Millions)	PA Cost/Annual kWh or therm	Consultant Cost/Annual kWh or therm	2013 Actual Cost to Achieve	2014 Actual Cost to Achieve
Electric	\$1,818	\$1,764	\$0.518	\$0.418	\$0.379	\$0.376
Gas	\$623	\$670	\$8.330	\$6.775	\$6.148	\$5.973

RESIDENTIAL SAVINGS ANALYSIS

Residential Electric Savings

Since the last update in July, the Consultant Team and PAs have continued to meet by telephone and exchange information on the Lighting, Behavioral, and Home Energy Services Initiatives. This updated assessment on residential sector goals is based on those discussions, additional research by the Team, and revised data from the PAs.

Lighting Initiative

- **Original Assumptions:** Ambitious assumptions for lighting units/housing units and percent of LEDs; other factors are gross savings and NTG. In July the difference between the PAs’ planned numbers and the Consultants’ revised goal projection was approximately 280,000 MWh (2016-

18).

- **Updated Assumptions:** Based on additional information provided by the PAs and the Consultants' own research, the Consultant Team revised its assumed LED unit share from 70%, 85%, and 100% in 2016-2018 respectively to 65%, 78%, and 90%. This results in reduced savings of approximately 0.5% from the Consultants' revised lighting goals. The Consultants also applied previously omitted values for in service rates (which adjust for whether purchased bulbs are actually installed) and readjusted our allocations for units between various lamp types to more appropriately match our larger overall unit assumptions. This reduced the Consultants' Lighting Initiative savings estimates by approximately 9%. The Consultants requested and received from the PAs an update on YTD (through end of June) lighting unit activity. The Consultants project this will result in a total of 9.2-9.4 million lighting units by the end of 2015. Therefore, the Consultants believe there is no basis for changing our lighting unit estimates for 2016-2018.
- **Potential Impact on Goals:** The difference between the PAs' planned numbers and the Consultants' revised goal projection is approximately 194,000 MWh (2016-18).

Behavioral Initiative

- **Original Assumptions:** Increased participation and increased savings per participant. In July the difference between the PAs' planned numbers and the Consultants' revised goals projection was more than 140,000 MWh (2016-18).
- **Updated Assumptions:** The PAs and Consultants met again by telephone on July 28 to discuss assumed savings and participation. The PAs maintain that no additional participants are available. The Consultants have requested additional information from Eversource to support its assertion given an apparent difference between the percentage of its customers being treated when compared to National Grid. The Consultants did agree to reduce assumed savings per participant increases in 2016 and 2018 given the relative maturity of the Opower behavioral efforts. A savings increase in 2017 is maintained to spur innovation in the existing program model.
- **Potential Impact on Goals:** The difference between the PAs' planned numbers and the Consultants' revised goals projection is approximately 109,000 MWh (2016-18).

The table below shows the annual residential electric goals as originally proposed by the Consultant Team in April and an updated goals calculation with the evaluated 2014 numbers from the PAs.

Table 5. Consultant Team Residential Electric Savings Goals

Year	Annual Savings as a % of Sales (Original 4/23)	Annual Savings as a % of Sales (Revised 8/4)	Annual Savings as a % of Sales (Revised 8/12)
2016	3.38%	3.36%	3.40%
2017	3.47%	3.42%	3.51%
2018	3.55%	3.37%	3.52%
2016-2018	3.47%	3.38%	3.48%

Residential Gas Savings

Behavioral Initiative

- **Original Assumption:** Increased participation as a result of Columbia Gas introducing a behavior initiative and increased savings per participant statewide in 2017 from existing behavioral effort program innovation.
- **Updated Assumption:** No change at this point in time. Consultants' understanding is that

Columbia Gas continues to assess a behavioral offering. During the July 28 call the PAs and Consultants also discussed a decrease in behavioral savings from 640,098 MMBtus in 2014 to 542,976 MMBtus in 2016. The Consultants believe there is sufficient room in National Grid's BCR (2.42 in 2016) to support a higher savings goal.

- **Potential Impact on Goals:** The difference between the PAs' planned numbers and the Consultants' revised goals projection is approximately 7 million therms.

HES Initiative

- **Original Assumption:** Steadily increasing participation and savings per participant.
- **Updated Assumption:** No change at this point in time. The PAs and Consultants had a follow up discussion on July 28 and the PAs provided additional information, primarily related to cost drivers. The Consultants asked for additional details, some of which were provided on August 11 and some of which are still pending. The PAs indicated they are largely in alignment with the Consultants' participation assumptions, so the remaining difference is in assumed savings per participant.
- **Potential Impact on Goals:** The difference between the PAs' planned numbers and the Consultants' revised goals projection is 4 million therms.

The table below shows the annual residential gas goals as originally proposed by the Consultant Team in April and an updated goals calculation with the evaluated 2014 numbers from the PAs from July and other updated assumptions.

Table 6. Consultant Team Residential Gas Savings Goals

Year	Annual Savings as a % of Sales (Original 4/23)	Annual Savings as a % of Sales (Revised 8/4)	Annual Savings as a % of Sales (Revised 8/12)
2016	1.52%	1.56%	1.56%
2017	1.71%	1.74%	1.74%
2018	1.82%	1.82%	1.82%
2016-2018	1.68%	1.71%	1.71%

RESIDENTIAL COST ANALYSIS

The Consultant Team has reviewed the PAs' 2016-2018 planned costs for Residential Sector electric and gas savings. The Team met with several of the PAs to discuss the main drivers that may lead to increased costs over the next three years. The primary focus has been annual cost rates, which are presented below. It should be noted that lifetime cost rates are also an important indicator, presenting a more complete picture of costs and savings benefits over time. For the costs and savings analysis for the Council in April, the Consultant Team's primary focus was on developing savings goals. For a simple initial approach to estimating costs, we took the PAs' 2014 initiative level cost rates (Q4 results at the time, since updated to reflect final 2014 budgets), applied an annual inflation rate, and applied the inflated cost rate to our savings goals.¹ Since that original analysis the Consultants have sought to identify the primary cost drivers that could prompt revisions to the general approach of flat costs plus inflation. The primary key drivers and remaining cost differences are described more fully below.

Residential Electric Costs

¹ To derive the sector level cost rate, the Consultants originally added in an estimate of the PAs' Hard to Measure budget and then used the PAs' Plan HTM budget \$.

While the Consultants agree that there are market forces that may cause electric costs to rise, there are also factors that should have the opposite effect and mitigate the upward pressure, most notably declining LED prices, which are discussed further below. In general, the Consultants believe that PA costs and 40% higher cost rate as presented in the draft April Plan are substantially overstated, especially for lighting, which is also a significant factor in HES costs and savings.

The residential electric initiative-level cost rates for which there are the biggest differences between the Consultants and PAs are those for Lighting and HES. For lighting, the PAs' three-year average annual cost rate from the April draft is \$0.24/kWh vs. \$.19 for the Consultants. This is primarily due to the PAs' higher assumed incentive levels, especially for LEDs, which remain unchanged over the three years of the Plan. The Consultants believe market forecasts support declining prices over time and have therefore assumed declining incentives over time. Differences in assumed total unit numbers and LED/CFL unit share with associated impacts on savings are also factors in the cost rate differences. The PAs have indicated their revised draft Plan will include lower costs though the Consultants have not yet received firm numbers. The Lighting Initiative represents approximately 19% of the total residential sector three-year electric budget in the April draft Plan.

The HES Initiative constitutes 42% of the total residential sector three-year electric budget in the April draft Plan. On an average annualized basis, the draft HES electric budget increases 20% from 2014 while savings decline slightly, which results in a cost rate increase of 42%. Through the key drivers process the PAs have indicated that increased HES costs include higher costs for insulation resulting from a code issue, increased compensation for contractors, and enhanced incentives for moderate income customers (estimated to comprise approx. 7% of HES participants), and whole building weatherization. They did not note any specific key drivers that could decrease costs.

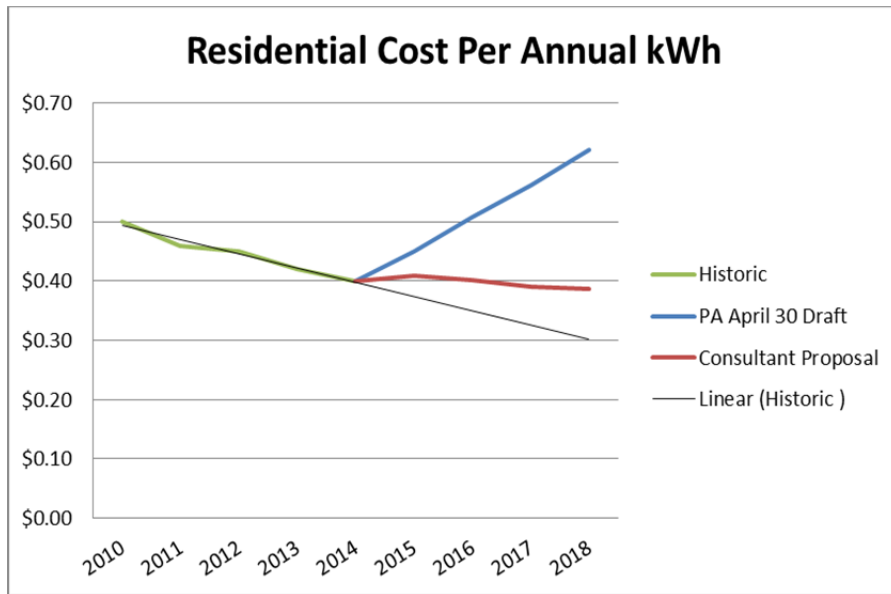
The Consultants believe there are opportunities for reduced costs and additional cost efficiencies. As with the Lighting Initiative, we believe that lighting costs in HES, which comprise 24% of the HES 2016 incentive budget and 16% of the 2016 Initiative budgets, are overstated in the draft Plan. Similar to the retail lighting initiative, PA LED costs remain unchanged over the Plan's three years. While lower costs allow the PAs to include more expensive LED products such as three-way and candelabra bulbs, we nonetheless would expect to see some significant LED cost reductions by 2018. In addition, we believe there may be an opportunity to decrease QC sampling rates for HES, which are currently as high as 60% in Massachusetts vs. an average of 25% for all Home Performance with ENERGY STAR program providers.

Taking these and other factors into consideration, the Consultants have increased our initial cost rate (flat costs plus inflation) by 15% with a resulting initiative-level cost rate of \$1.27 vs. \$1.50 for the PAs. The Consultants' assessment is applied generally to the HES cost rate, as the type of information provided to the Consultants, uncertainty regarding specific measure quantities, and the available staff resources do not support a measure-level approach to these costs.

The Multi-Family Retrofit Initiative is also a good candidate for a cost adjustment given several key cost drivers, including the increased insulation cost issue noted above and the assumed ability of the PAs to weatherize oil heated multifamily buildings for the first time assuming successful adoption of revised RCS regulations. At the same time, a pending multi-family impact evaluation with significant expected downward implications for PA savings and differences between PAs in key planning assumptions should be resolved before cost adjustments are applied.

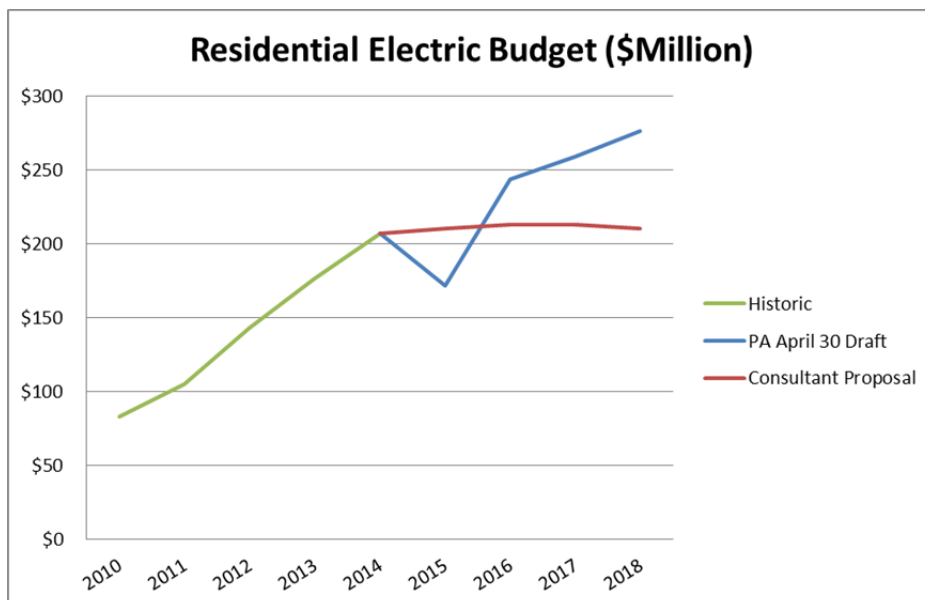
The historic, PA planned, and Consultant estimated costs are shown in the figure below. The figure suggests that the Consultants predict increased costs for the next three years, but at a rate increase much closer to the historic trend line.

Figure 3. Residential Cost Per Annual kWh



The Consultant Team predicts lower costs per annual kWh saved and more savings than the PA April plan. The net result is a slight increase in the Consultants’ average annual Residential Sector budget in 2016-18 as compared to the PAs’ 2014 levels, shown in the figure below. The PAs’ three-year sector budget is 29% higher than the Consultants. The flattening of the Consultant Team residential budget is largely due to an expected decline in LED costs over the 3 years of the plan—which the PAs have not included in their draft budgets—a higher proportion of savings from the Lighting and Behavior Initiatives with lower cost rates, and lower assumed HES savings.

Figure 4. Residential Electric Budget



Residential Gas Costs

The Consultant Team also looked at PA projected gas costs and savings. The April draft Plan shows an average increase in the Residential Sector cost per annual therm of 39% for 2016-18 as compared to 2014. The increase in the PAs' anticipated costs to deliver are the result of both increased budgets (annual average of 34% higher) and decreased savings (annual average of 12% lower).

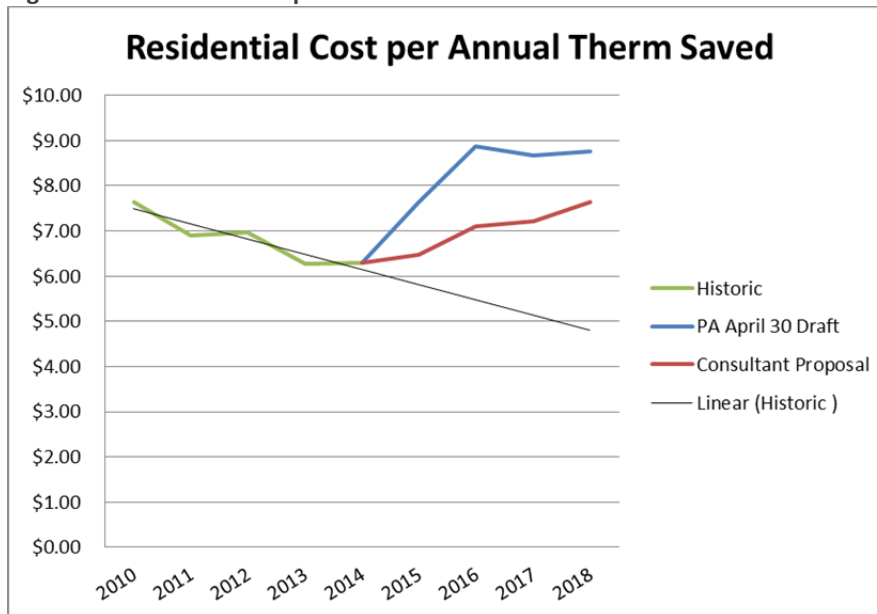
Increased costs for the Home Energy Services Initiative, which represents 49% of the total Residential Sector gas budget, are the most significant driver in the increased PA cost rates. The PAs' average annual cost rate for HES increases more than 30% over 2014. The key cost drivers for electric and gas are similar as are the Consultants' assumed cost savings as previously discussed in the electric section of the memo. The Consultants have applied the same adjustment to our assumed costs for gas HES, with a resulting cost rate of \$14.16 as compared to the PAs' \$15.52.

The other residential gas initiatives with significant cost rate differences between the PAs and Consultants are Multi-Family Retrofit and Heating and Water Heating. The issues noted above for electric Multi-Family Retrofit are similar to gas (with the exception of oil costs and savings) and therefore the Consultants have made no adjustments at this time. Any adjustments to Multi-Family Retrofit will have a relatively small impact on the overall sector, given that its budget is 7% of the total. The Consultants believe that the cost rate for the Heating and Water Heating Initiative could be reduced by increasing the number of wireless communicating thermostats, which we understand the PAs are planning for the revised draft.

Given the large overall savings and comparatively low cost rate for the Behavioral Initiative (\$.57/therm), increasing behavioral savings would also have an overall beneficial impact on the Residential Sector gas cost rate. The PAs assume a decrease in gas behavioral savings in 2016-18 as compared to 2014. National Grid, with 83% of statewide gas behavioral savings in 2014, has the biggest impact with a 16% reduction in savings from 2016 to 2014. The Consultants assume 2014 levels will continue to be achieved and will increase. National Grid's 2016 BCR of 2.42 also allows room for higher savings.

The figure below shows the historic cost per annual therm of savings, as well as the PA planned and Consultant estimated costs.

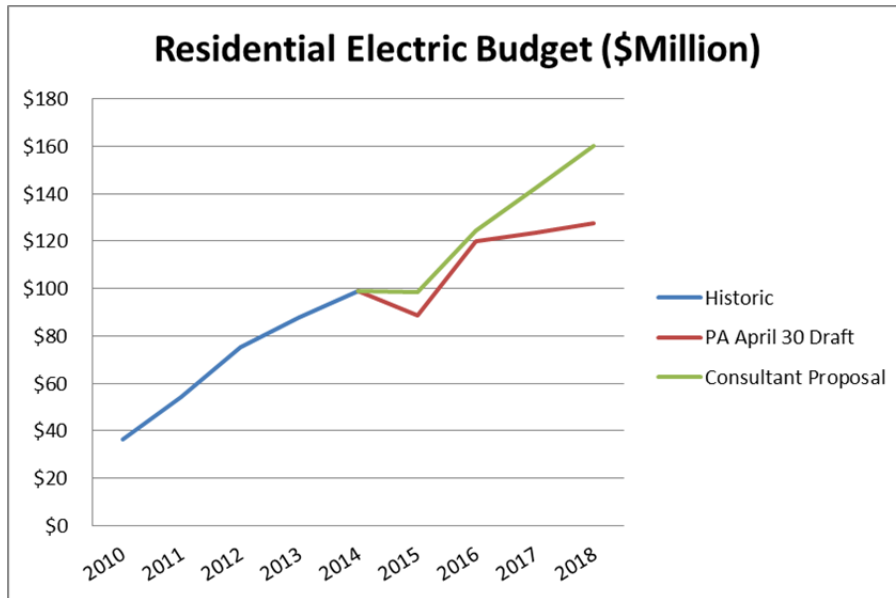
Figure 5. Residential Cost per Annual Therm Saved



The figure below shows the effect that cost per annual therm and the amount of savings has on the budget. The

PAs' three-year budget is actually lower than the Consultants' by 15%, but PA savings are 39% lower than ours.

Figure 6. Residential Gas Budget



LOW INCOME SAVINGS ANALYSIS

The Consultant Team's Low Income Sector Savings goals were derived by increasing Low Income Sector electric savings as a percent of retail sales to 2.25% in each of the three years from the 2014 level of 2.23%. The Team continued gas savings at the 2014 rate of 2.41% of retail sales. The Consultants' approach yields higher savings estimates than the PAs' by 29,000 MWh for electric and 1.6 million therms for gas over the three years. With the primary focus on the Residential Sector, the Team has not had an opportunity to conduct a full initiative-level analysis for the Low Income sector or discuss this sector with the PAs. The Team feels that its approach is reasonable and appropriate given the proven program delivery infrastructure and strong results of the current Three-Year Plan period. The Consultants and PAs plan to meet on August 13 and will update the Council on any relevant outcomes of that and other discussions.

Table 7. Consultant Team Low Income Savings Goals

Year	Annual Electric Savings as a % of Sales (Original 4/23)	Annual Gas Savings as a % of Sales (Revised 8/4)	Annual Gas Savings as a % of Sales (Revised 8/12)
2016	2.25%	2.25%	2.41%
2017	2.25%	2.25%	2.41%
2018	2.25%	2.25%	2.41%
2016-2018	2.25%	2.25%	2.41%

LOW INCOME COSTS ANALYSIS

The Consultants have applied the same initial approach to costs as used for the Residential Sector analysis. This included taking the PAs' 2014 sector level cost rates, applying an annual inflation rate, and applying the inflated cost rate to our savings goals. This yields the following differential in low income cost rates:

Table 8. Cost Rate Comparison

Annual cost rates	PAs Plan avg. 2016-2018	Consultants avg. 2016-2018
Electric (\$/kWh)	\$1.75	\$1.30
Gas (\$/therm)	\$19.19	\$14.98

As noted above, the Consultants have not yet had an opportunity to meet with the PAs to discuss low income sector specific cost drivers and have scheduled a meeting for August 13. We expect to learn that many of the cost drivers the PAs noted during the Residential Sector discussions will also apply to the Low Income Sector, including the ability to weatherize oil heated multifamily buildings with additional costs but little to no savings and increased insulation costs. We are also planning to look more closely at assumed lighting costs, as this may represent a costs savings opportunity similar to for the Residential Sector. Once the additional information is in hand we may well feel an adjustment to our cost assumptions is appropriate and will provide an update.

COMMERCIAL AND INDUSTRIAL SAVINGS ANALYSIS

C&I Electric Savings

The key driver analysis process has included a review of three C&I topics. This process, specifically with respect to CHP, C&I lighting, and streetlights is ongoing, but has led to some preliminary revisions in the assumptions and analysis. The details are outlined below.

Combined Heat and Power

- **Original Assumption:** A robust pipeline of 78 MW of identified capacity could yield significant savings. We did not include an assumption of any as-yet-unidentified CHP projects.
- **Updated Assumption:** The Consultants have reviewed the pipeline and potential projects with the PAs and DOER, and even spoken to one customer with a large project to determine the likelihood of project completion by 2018. Other customers are also being polled on the likelihood of project completion between 2016 and 2018. Some of the identified projects, originally assumed to be complete in the three year plan time period, are now assumed to have a completion data after 2018, and at least one large project is not expected to go through the efficiency programs if it happens at all. The project pipeline was weighted by the PAs according to the likelihood of project completion in the plan timeframe. Weighting a pipeline of identified projects according to the estimated likelihood of project completion is a common method to estimate results. The Consultants and DOER modified the weighting on one very large project as the result of positive feedback from the customer that they fully intended to complete the project by 2018. This had the effect of increasing the weighted pipeline estimates. An assumption was also made to add 5 MW to the pipeline as “unidentified” as the result of the hiring of a new dedicated CHP person at National Grid, and assumptions were made about potential savings from projects of less than 1 MW for National Grid and Eversource. The resulting change from these assumptions indicates that the weighted pipeline predicts at least 42.4 MW of capacity being installed between 2016 and 2018, resulting in an estimated 252 GWh in savings
- **Potential Impact on Goals:** The BCR models include 117 GWh of savings from about 20.6 MW of installed capacity. The difference between the adjusted weighted pipeline and the BCR models is 135 GWh.

Small Business

- **Original Assumption:** If all PAs at least meet the current average savings per participant, and the number of participants stays constant at 2014 levels, there would be an increase in savings.

- **Updated Assumption:** Planned incremental improvements to the program should make increased savings per participant more likely. The Consultants are projecting that participation will increase from 6589 customers in 2014 to 6789 in 2018.
- **Potential Impact on Goals:** Massachusetts could save at least 50 GWh more over 2014 levels between 2016-18 if all the PAs saved an average amount per customer in the Small Business program. The difference between the PAs and the Consultants is 50 GWh.

Streetlights

- **Original Assumption:** There are approximately 345,000 streetlights in Massachusetts that use old, inefficient technology. This pool of streetlights represents 105,000 MWh of potential savings. The Consultants assumed that 60% of the lights could be converted during the 2016-18 timeframe.
- **Updated Assumption:** Additional analysis was performed to identify the potential savings based on light ownership. There are about 124,000 non-LED streetlights that are municipal owned, and 154,000 that are utility owned. This represents 37,000 MWh of potential savings with municipal owned streetlights, and 51,000 MWh with utility owned, mostly in National Grid territory, in both cases. The utility owned streetlight potential can only be realized if the utility sells the lights or applies to the DPU for a LED tariff. Because the sale of the lights or a rate tariff will take time to implement, we are assuming only half the potential for utility owned streetlights can be realized in the next three years. There are also other factors that may restrict the potential, such as the market's ability—e.g., contractor capacity—to provide and install lights in the next three years.
- **Potential Impact on Goals:** Streetlights are being analyzed in conjunction with all C&I lighting. Streetlights could contribute an estimated 53 GWh over the next three year plan.

C&I Lighting

- **Original Assumption:** While linear LED lamps were called out specifically in the Consultant memo, there were no savings increases or decreases predicted at the time.
- **Updated Assumption:** A recent forecast of the Vermont commercial and industrial lighting market shows the potential for a significant increase in lighting savings over the next few years from the adoption of linear LEDs, LED retrofit kits, and LED fixtures. Other forecasts from DOE and California project alternate rates of adoption, and all show increased LED market share, but on different timelines. The Consultants did an analysis to project the rate of LED fixture and TLED adoption in Massachusetts to determine to what extent it could offset the PA projected decline in C&I lighting due to the saturation of the screw in LED market. The PAs are currently predicting that C&I lighting savings in 2016-2018 will decline from 2014 levels by about 22%. The Consultant projection of savings from LED fixtures and linear LEDs (TLEDs) does not fully offset the PA predicted decline, but does bring projected C&I lighting savings in 2018 back up to 2014 levels. The Consultants are estimating 190 GWh of increased savings from LED fixtures and TLEDs, after subtracting out savings that would have come from High Performance T8 projects.
- **Potential Impact on Goals:** While the Consultants agree that the likelihood of savings from C&I projects will decline from 2014 levels in the short term, the Consultants disagree that the level of savings will stay flat from 2016 through 2018. The difference between the PA and Consultant positions is 190 GWh over the three years.

Mid-Sized Customers

- **Original Assumption:** While mentioned in the Consultant Team memo, there was no specific number assumed or included in the initial analysis for additional savings from mid-sized customers.
- **Updated Assumption:** Additional savings are available from mid-sized customers. The Consultants assume that 25% of the identified potential from unmanaged mid-sized customers can be realized during the next Three-Year plan. The potential is listed in Table 1-3 on page 1-11

of the Mid-Sized Customer Needs Assessment.

- **Potential Impact on Goals:** The projected savings increase is 24 GWh over three years, compared to no incremental savings assumed in the first Consultant memo.

The table below shows the changes in C&I electrical goals based on the updated assumptions described above.

Table 9. Consultant Team C&I Electric Savings Goals

Year	Annual Savings as a % of Sales (Original 4/23)	Annual Savings as a % of Sales (Revised 8/12)	Annual Savings as a % of Sales (Revised 8/12)
2016	2.82%	2.56%	2.56%
2017	2.86%	2.81%	2.81%
2018	2.91%	3.08%	3.08%
2016-2018	2.86%	2.82%	2.82%

C&I Gas Savings

No adjustments are currently considered except to the underutilized technologies as described below.

Underutilized Technologies (Gas)

- **Original Assumption:** Opportunity exists in the C&I sector for increased measures such as ozone laundry, microbead laundry, and industrial process.
- **Updated Assumption:** A reevaluation of these technologies changes the predicted savings downward slightly.
- **Potential Impact on Goals:** The Consultant Team concludes that increased savings of an estimated 450,000 therms are possible from increased ozone laundry (or other laundry technologies) and industrial process improvements. The table below shows the changes in C&I gas goals based on the updated assumptions described above.

Table 10. Consultant Team C&I Gas Savings Goals

Year	Annual Savings as a % of Sales (Original 4/23)	Annual Savings as a % of Sales (Revised 8/4)	Annual Savings as a % of Sales (Revised 8/12)
2016	1.13%	1.01%	1.01%
2017	1.12%	1.03%	1.03%
2018	1.14%	1.05%	1.05%
2016-2018	1.13%	1.03%	1.03%

Small Gas PAs

The Consultants reviewed the potential studies done by GDS for Berkshire, Liberty and Unital. These potential studies provided both a “Likely Achievable” potential and a “High-Case” for C&I customers. While the Consultants still have questions about these studies, we did look to see how the Small Gas PAs plans compared to the GDS identified potential. GDS provided results for commercial and small industrial customers as one group, and for large industrial customers as a separate group. The Consultants added the projected savings for these two groups together and divided by total sales for these same groups to calculate C&I Likely Achievable and High-Case figures for each plan year. It is important to note that for all three PAs, the C&I programs achieved a higher level of savings in 2014 than projected by the GDS studies “High-Case” scenario. In fact, all three programs exceeded 1% savings as a percentage of sales, with Berkshire achieving 1.09%, Liberty at 1.04%, and Unital at

1.94%. In setting goals for the 2016-18 plan, all three PAs set goals below 1% and within the boundaries of the GDS Likely Achievable and High-Case scenarios as seen in Figure 7. The GDS range is indicated by the vertical black range bars. The Consultants do not disagree significantly with these small PA estimates and only increased the goals slightly as seen in Figure 8, which shows the slightly higher Consultant Estimated goals as compared to the GDS potential.

Figure 7. Small PA Sales Goals Comparison

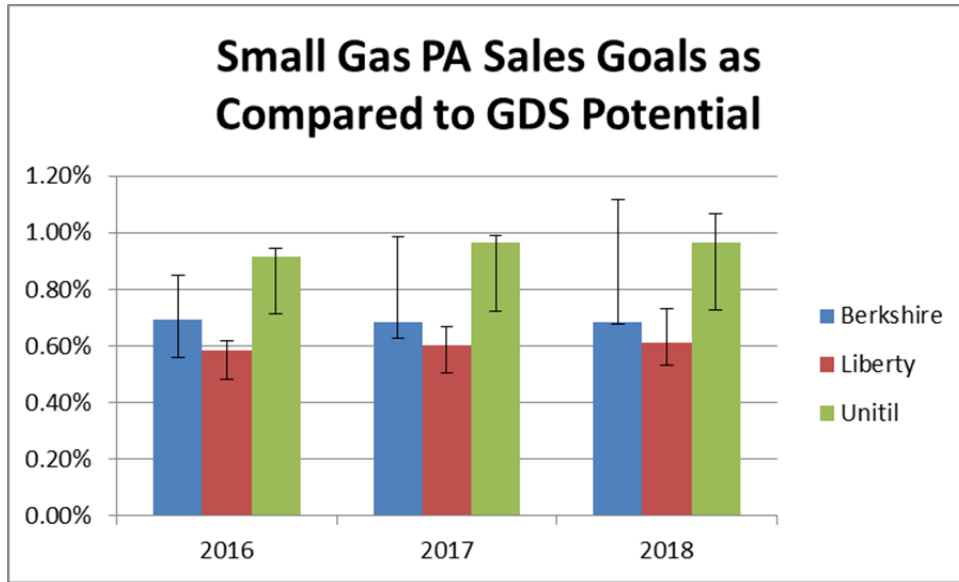
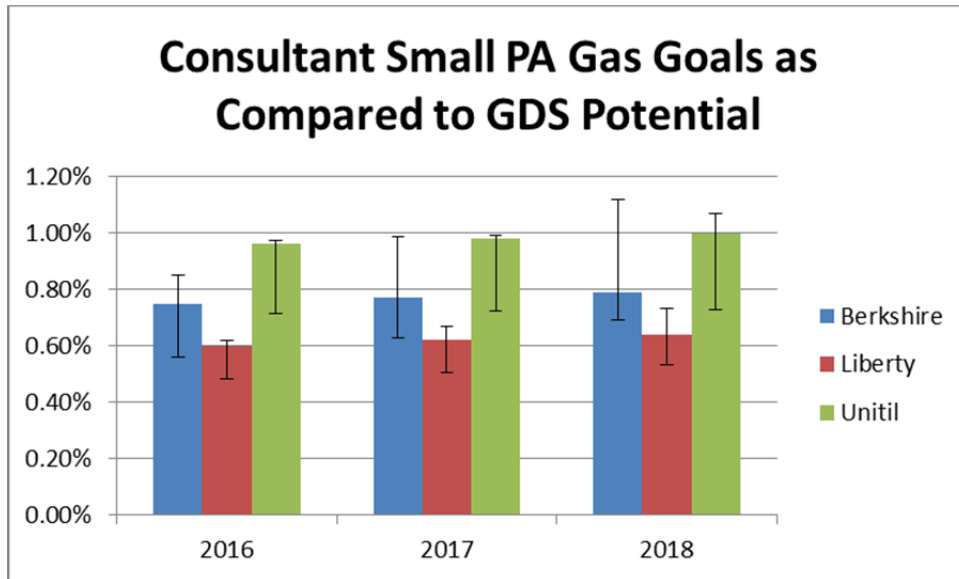


Figure 8. Consultant Small PA Goals Comparison



Again, it should be noted that because gas sales are expected to increase, the consultants do not expect large increases in savings from the small PAs as a percentage of sales.

COMMERCIAL AND INDUSTRIAL COST ANALYSIS

C&I Electric Costs

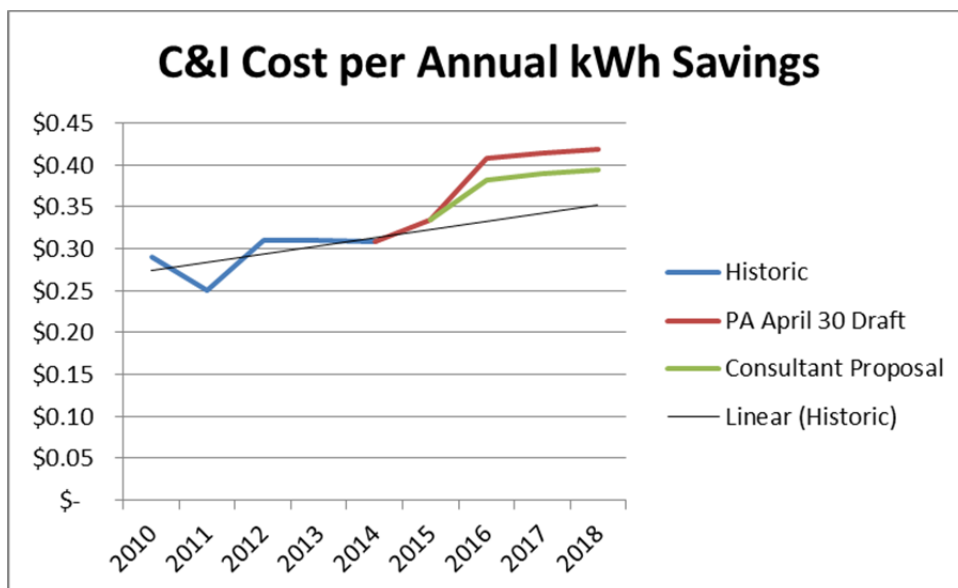
The Consultant Team has reviewed the PA's 2016-2018 planned costs for C&I savings and discussed the drivers that may lead to increased costs over the next three years with the PAs. While the Consultants agree that there are market forces that may cause costs to rise, there are also factors that should have the opposite effect and mitigate the upward pressure. For example, CHP is very cost effective, and can reduce the average cost per kWh in the next Three Year Plan. In addition, the costs of LED lighting such as linear LED lamps and LED luminaires will continue to decline. For example, the cost for linear LED lamps was projected by the DOE to decline from \$89 per thousand lumens (klm) in 2015 to \$60/klm in 2020.² LED luminaires are similarly projected to decline in cost from \$89/klm to \$62/klm over the same time period. A new report from the DOE puts the cost for LED luminaires at the end of 2014 at \$53/klm and linear LED lamps at 17/klm, exceeding the previous price reduction projections.³ LED efficacy continues to improve as well. The Consultants therefore expects costs to rise on a dollar per annual kWh basis, but not as quickly as the Program Administrators' plans.

Market factors will contribute to increased costs in the following ways:

- Small Business DI Costs are expected to continue to rise, but not as fast as anticipated by the PAs.
- Streetlight conversions are expensive, but are assumed to decline in cost from \$928/MWh to \$875/MWh during the next three years.
- Linear LED lighting is expensive, but assumed to decline from \$550/MWh to \$500/MWh. As LED lighting replaces linear fluorescent lighting, savings costs will increase initially but will decline over time.

The historic, PA planned and Consultant estimated costs are shown below in Figure 9. The figure suggests that the Consultants predict increased costs for the next three years, but at a rate increase much closer to the historic trend line.

Figure 9. C&I Cost per Annual Savings

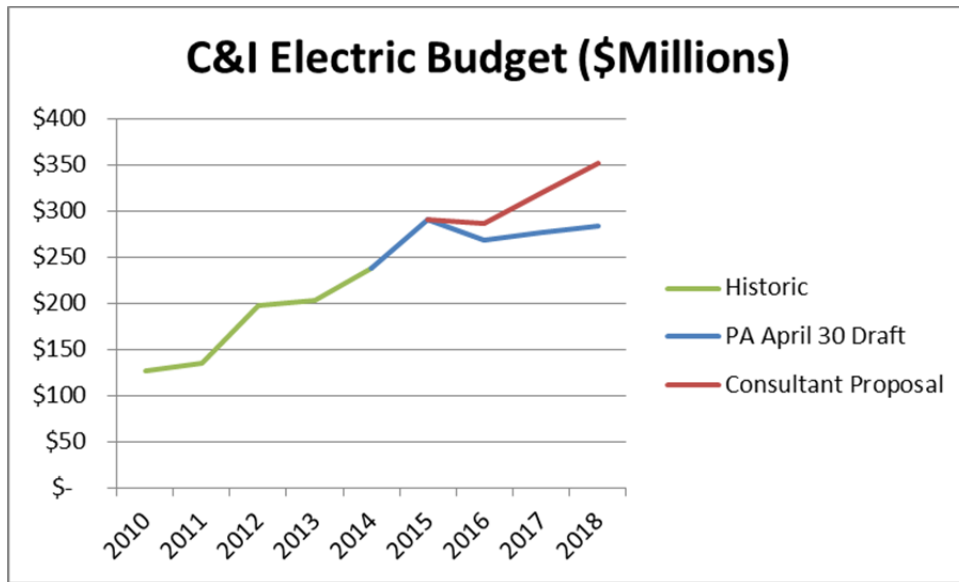


² <http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/energysavingsforecast14.pdf> Table E.9 Page 51

³ http://energy.gov/sites/prod/files/2015/07/f24/led-adoption-report_2015.pdf Page 28

The Consultant Team predicts lower costs per annual kWh saved and more savings than the PA plan. The net result is increased spending on the C&I programs in 2016-18.

Figure 10. C&I Electric Budget



C&I Gas Costs

The Consultant Team also looked at PA projected gas costs and savings, which vary widely by PA. The general trend has been a gradual increase in the cost of an annual therm saved. The C&I PA plans show a significant increase in the cost per annual therm for 2016-18, driven largely by an anticipated 51% increase in average savings costs by National Grid. While most PAs show an increase in anticipated costs, the fact that National Grid sells about 57% of all the natural gas used by C&I customers in Massachusetts, combined with the magnitude of National Grid’s cost increase, has the greatest effect on statewide costs. The increase in anticipated costs by the PAs is mirrored by an anticipated decrease in savings. The plan shows a 23% average statewide decrease in anticipated savings for the plan years as compared to 2014 actual achievement. This decrease also varies widely among the PAs, with Eversource predicting the smallest decrease of 7%, and Unitil anticipating the largest decrease of 51%.

It should be noted that C&I gas sales are projected to increase significantly, which has the effect of making gas savings smaller as a percentage of sales.

The Consultants see no evidence or justification for cost increases and savings reductions as provided in the PA C&I gas plan. The Consultants adjusted the magnitude of the savings on an individual PA basis, based on past performance and statewide market share. It is logical that National Grid, with 57% of C&I sales and 54% of the energy efficiency budget, should be expected to achieve savings proportional to their sales and budget. As it currently stands in the plan, National Grid is only projecting savings of 40% of the state C&I total. By comparison, Columbia and Eversource receive 14% and 26% of the statewide efficiency budget, yet are projecting to save 19% and 35% of the statewide total. This indexing indicates that National Grid has an opportunity to increase savings with their planned budget. To arrive at the currently recommended level of costs and savings, the Consultants increased National Grid’s share of savings to a 51% share of statewide savings. For costs, National Grid is budgeting the highest costs of all PAs at an average of \$6.35 per therm. Discussions with the National Grid indicate that this is being driven partly by a significant amount of planned savings from C&I Multifamily at over \$12/therm. The Consultants reduced National Grid’s projected costs to \$4.60/therm in 2016, \$4.70/therm in 2017, and \$4.80/therm in 2018. This Consultant adjusted average cost of \$4.70/therm for National Grid is still more than a dollar per therm higher than the next two largest PAs, Eversource and Columbia, who are projecting average costs of \$3.58 and \$3.51 respectively.

Figure 11 shows the historic cost per annual therm of savings, as well as the PA planned and Consultant estimated costs.

Figure 11. C&I Cost per Annual Therm

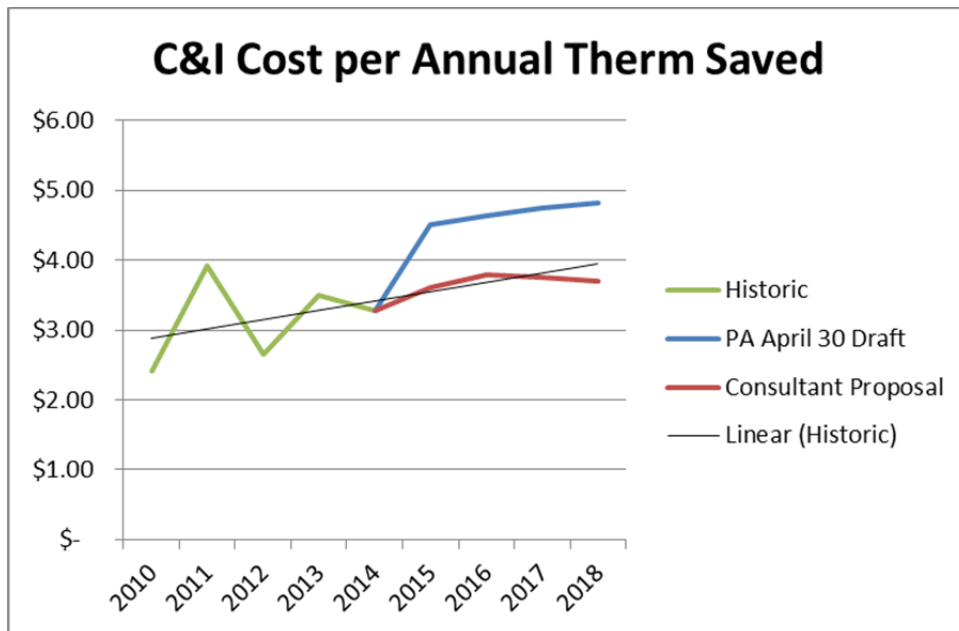
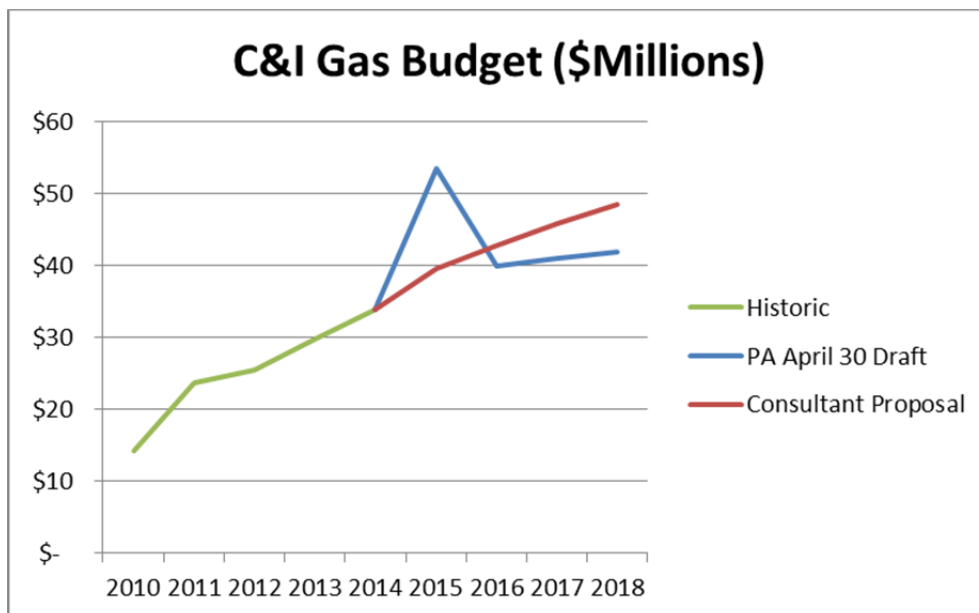


Figure 12 shows the effect that cost per annual therm and the amount of savings has on the budget.

Figure 12. C&I Gas Budget



CONCLUSION

Through the key drivers process, the Consultant Team has worked collaboratively with the PAs to review

important assumptions impacting savings and costs. Additional analysis and discussions has resulted in adjustments to the Consultant's achievable savings for various fuels, sectors and initiatives. Although the process is still on-going, current information on savings has largely strengthened the Consultant Teams' position that the 2016-18 goals put forward are achievable and cost-effective. The Consultant Team will continue to review all available information and support the Council in the process of negotiating firm goals moving for the next three-year cycle.