# Industry and Agriculture Sector

## Production Efficiency Trends: Systems, Markets and Sources of Savings from 2009-2016

July 2017

Energy Trust of Oregon

## About Energy Trust of Oregon

Energy Trust is an independent nonprofit organization, overseen by the Oregon Public Utility Commission, to lead utility customers in benefiting from saving energy and generating renewable power. Our services, cash incentives and solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save more than $2.7 billion on their energy bills since 2002. The cumulative impact of our leadership since 2002 has been a contributing factor in our region's low energy costs and in building a sustainable energy future. More information about Energy Trust's background, funding sources, strategic and action plans, policies and programs are available on our website at www.energytrust.org.

## I. Analysis of trends in the Industry and Agriculture Sector

### Source of Data

Data contained in this report comes from Energy Trust's internal systems of record. It is for programs delivered in Oregon.

### Trend Analysis: Working and Reportable Savings Numbers

These analyses are primarily based on working savings numbers, which are savings before evaluation factors and transmission and distribution losses or credits are applied. Working savings will not match reportable savings, which are included in Energy Trust's public reports to the Oregon Public Utility Commission and board of directors.

We analyze trends using working savings for a few of reasons:

- Consistency: Evaluation factors change. Working savings provide a year-over-year comparison of market response to program offerings.

- Incentive designs and budgets are built on working savings, as verified first-year working savings are the basis for incentive payments to customers. Trends based on working savings are the basis of bottom-up goal setting and incentive budget development.

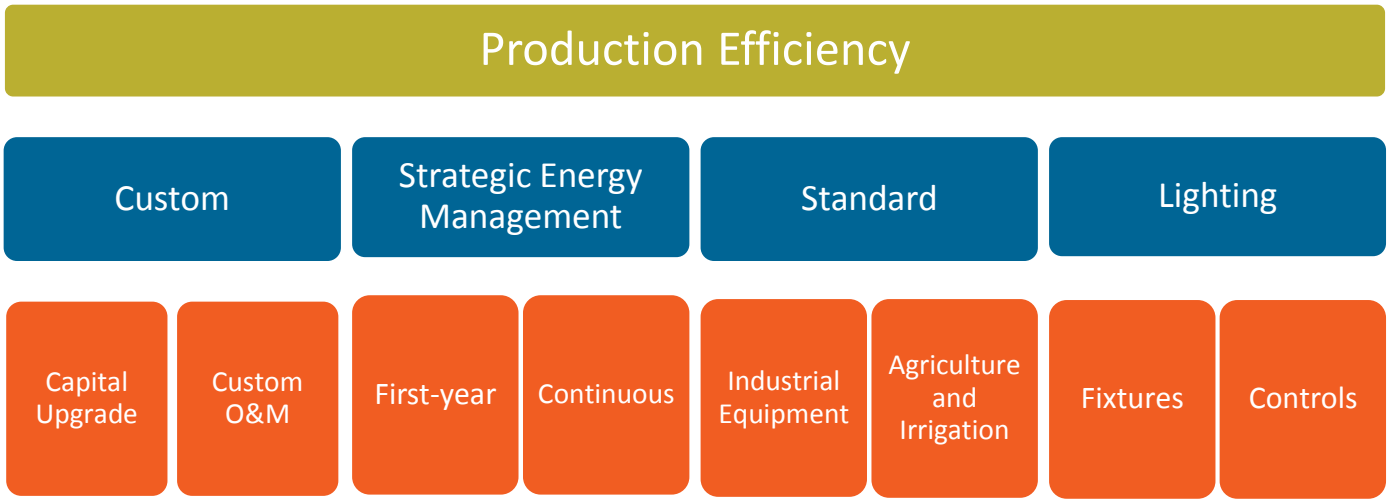
- Market drivers: While tracking and addressing changes in free ridership and technical realization is important to program outcomes, the primary driver of program outcomes is how the market responds to program offers. The secondary driver of outcomes appears to be customer perception of the current economy. This trend analysis focuses on the primary driver influenced by basic program design and delivery.

Megaprojects are projects that achieve very high savings and receive incentives above $500,000. They require board approval before they begin work. Megaprojects are not included in this analysis since they create spikes of activity that skews general program trends.

## II. Sources of Savings

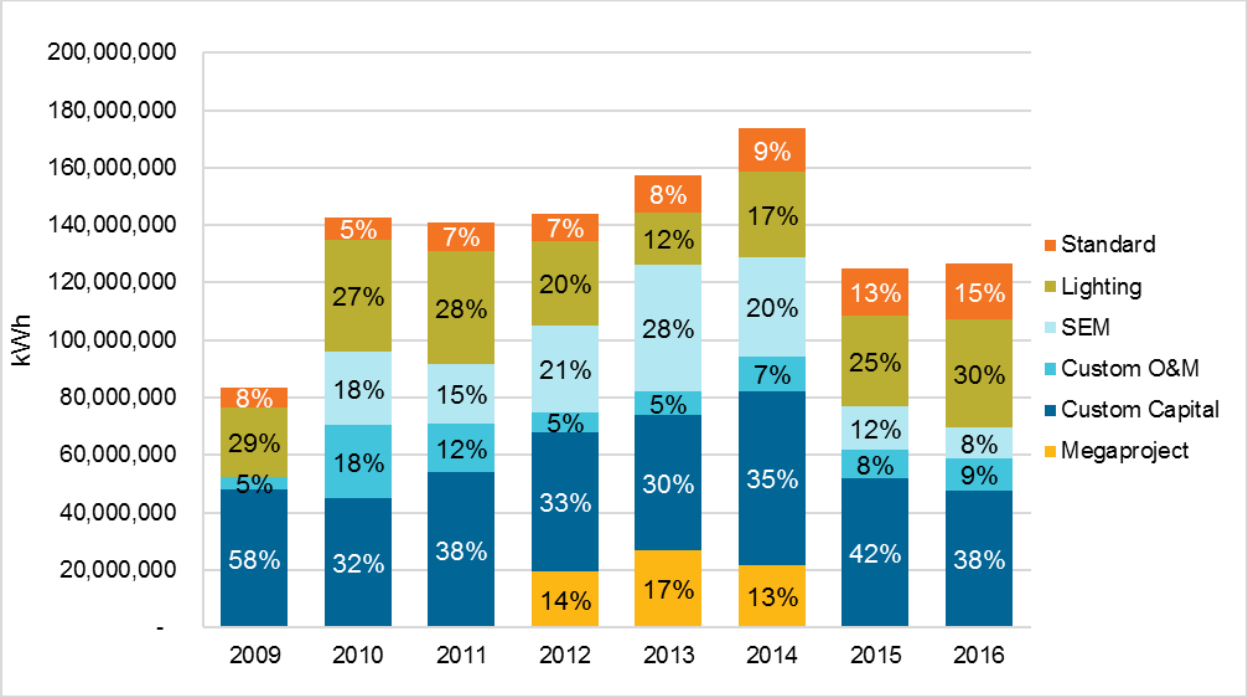
The Industry and Agriculture sector has one program, Production Efficiency. Production Efficiency is organized around and achieves savings through four primary pathways: custom, Strategic Energy Management (SEM), standard and lighting. Custom includes capital and operations and maintenance (O&M) projects. Each pathway is targeted to specific industry needs and/or market segments with differing technical complexity, delivery channels and development timelines.

**Figure 1**: Program pathways for savings



The program's historical electric and gas savings are detailed and analyzed showing the sources of savings in Figure 2 and Figure 7. This report also details project characteristics, types of savings and costs.

**Figure 2**: Electric sources of savings from 2009 – 2016 (working kWh)




** Megaproject savings are included only in this graph to provide the complete view of savings for the program.

Oregon manufacturers have weathered many changes since 2009—recession, economic recovery, and the ups and downs of the overall business climate. The contributions of the Industry and Agriculture Sector to the Energy Trust savings portfolio have remained relatively steady through it all, as staff adapted existing program offerings or created new ones to help customers maximize their energy efficiency opportunities. Staff effectively designed incentive bonus offers, particularly in 2011 and 2012, that proved successful in minimizing the impact of the recession on savings. Bonuses deployed in 2014 also helped level out savings as manufacturers maintained a cautious view of the market.

Some trends within the Industry and Agriculture Sector are fairly predictable. Custom capital energy projects tend to rise with the economy, while custom O&M projects increase when times are leaner. Other trends reflect the evolution of a mature program. The program, Production Efficiency has worked with many customers for multiple years, particularly those with larger sites. As a result, most of the large projects have been completed. A significant amount of savings can still be captured at these sites; however, these savings will be claimed through increasingly incremental efforts.

*Smaller customers*

The program expanded focus in 2014 to develop services and incentives to capture smaller projects at large customer sites, and to provide offerings for smaller customers. This strategy has worked to diversify the participant mix and to maintain overall savings. Since 2012, the number of small-to-medium participants has doubled as a percentage of all customers served. However, savings have lagged participation, and historical levels of total savings could not be sustained. As noted in the charts, a very high level of savings still remains to be achieved even as the era of numerous, very large projects has passed.

*Standard*

Standard projects, which include agricultural equipment for irrigation and greenhouses, are a growing contributor to program savings. Once in the single-digit percentages, in 2016 these projects represented 15 percent of the total. As the program engaged smaller industrial businesses, staff developed new standard track measures that complemented custom analysis and focused on delivering more cost-effective offerings to these new customers. For instance, a vendor-driven compressed air leak reduction approach was created in 2014. This offer helps small-to-medium companies that do not have the staff resources to fix and repair leaks. This offer also builds capacity in Energy Trust trade allies, while providing a vendor-driven service to the market.

*Strategic Energy Management*

Energy Trust introduced SEM to large industrial customers in 2009. Because SEM engagements are typically 12-15 months long and savings are claimed at the end of the engagement, the savings trends for SEM show up in the following year. The focus on identifying and addressing energy-efficiency opportunities with no- and low-cost O&M was a good fit for companies during the recession. In 2013, SEM was refined to include smaller sites. The program served a few large sites with very high SEM savings.

These exceptionally large engagements may mask a couple of factors that are impacting SEM savings: the general decline in overall SEM savings that occurred as a result of serving smaller sites with lower savings potentials, and the saturation of SEM at large sites. Over the next couple of years, Energy Trust continued to improve and expand the delivery of SEM, resulting in a smoother, more predictable flow of SEM savings from all customers. The results of these changes are beginning to be clear in 2016.

The Refrigeration Operator Coaching offering, a cold storage-focused version of SEM, was introduced in 2011 and offered through 2014 when staff determined this specific version of SEM had saturated the market. Cold storage facilities are now integrated into the regular SEM offerings. In 2014, the SEM offering was scaled for small and medium sites, several outside of the metro area and Willamette Valley. SEM savings in 2015 reflect the expansion of this offering. After the initial recruitment of non-metro sites in 2014, staff assessed the market potential for SEM in these areas and determined that regional cohorts are most effective for customers when implemented every 2-3 years.

*Lighting*

LED high-bay lamps and fixtures, which can operate for years without a loss of light quality, are a good fit for facilities where maintenance to change lamps can shut down a production line. As manufacturers recover from the recession, add shifts and see profits rise, LEDs provide multiple business benefits. From 2013-2016, lighting projects increased steadily by almost 20 million kilowatts-hours, a 106 percent growth, with the vast majority of the savings being LED upgrades.

In fall of 2011, Energy Trust's business programs together offered a bonus incentive for lighting to maintain savings from 2009 to 2010. The program posted high savings for 2011, but the lure of the bonus also had a result of depleting the project pipeline for 2012, resulting in a 35 percent drop in 2012 savings. Staff stepped back from year-end bonuses after this experience, particularly for those at year-end which exacerbated operational bottlenecks at the end of the year.

**Figure 3**: Top lighting measures from 2009 – 2016 (working kWh)

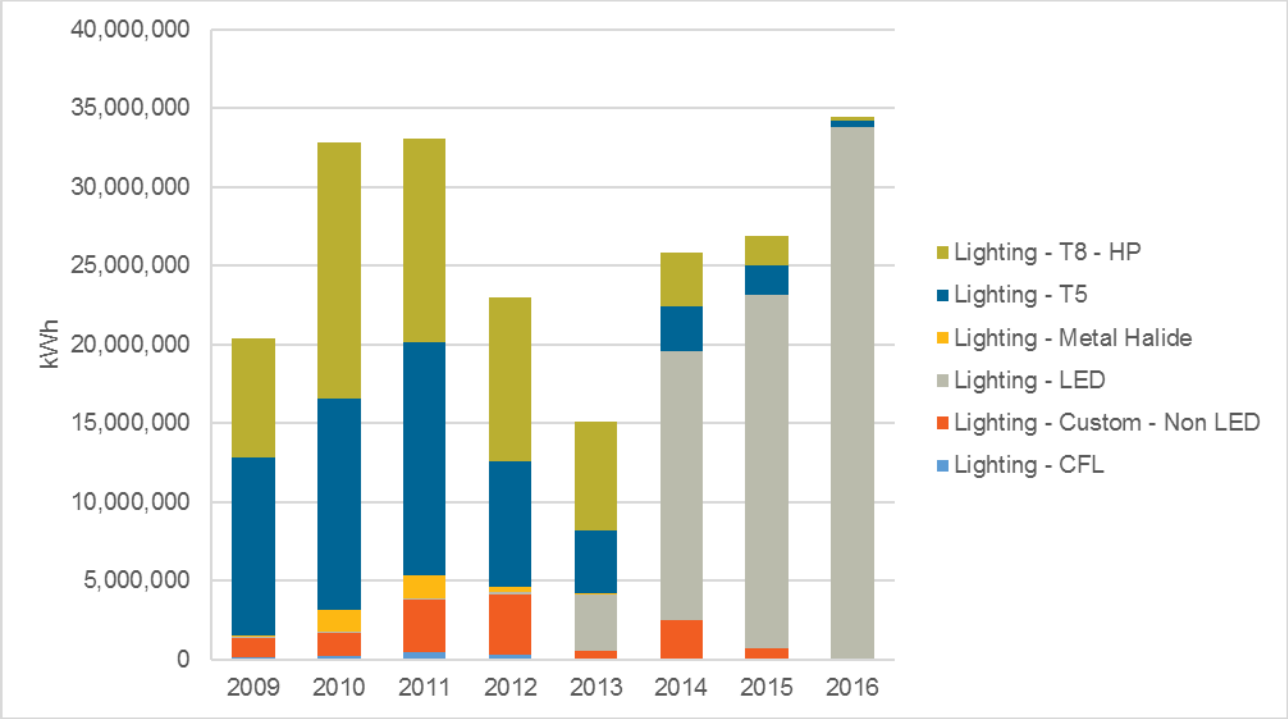
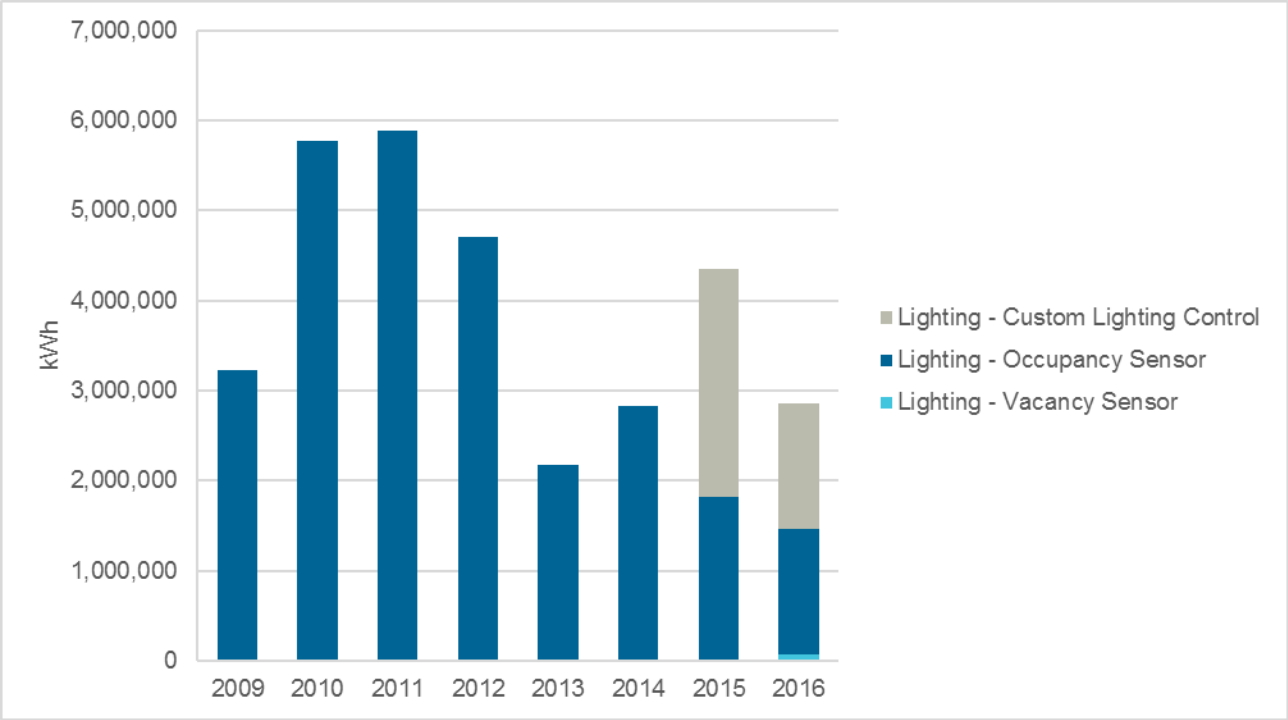



Figure 3 charts the level and composition of lighting savings since 2009. The transformative impact of LED lighting adoption is easy to see in the Industry and Agriculture sector.

The emergence of LED lighting at declining price points is transforming the lighting retrofit market for industry. This trend is due to a rebounding economy, desirable LED technology and declining equipment costs, all supported by Energy Trust's strong delivery network of lighting trade allies and a comprehensive set of lighting incentives. Other factors such as long lamp-life for reduced maintenance and better performance for improved lighting quality and safety attracted manufacturers of all sizes to LED lighting upgrades. LED technology effectively replaced fluorescent high-bay and exterior lighting products to become a nearly unanimous choice in 2016.

The appeal of LEDs may also have surfaced new--and frequently smaller--customers. These customers engaging with Energy Trust for the first time in 2016 overwhelmingly started with lighting, followed by standard incentives. New participants were predominantly small- to medium-sized customers. Staff are planning further analysis to map the customer path of these new participants.

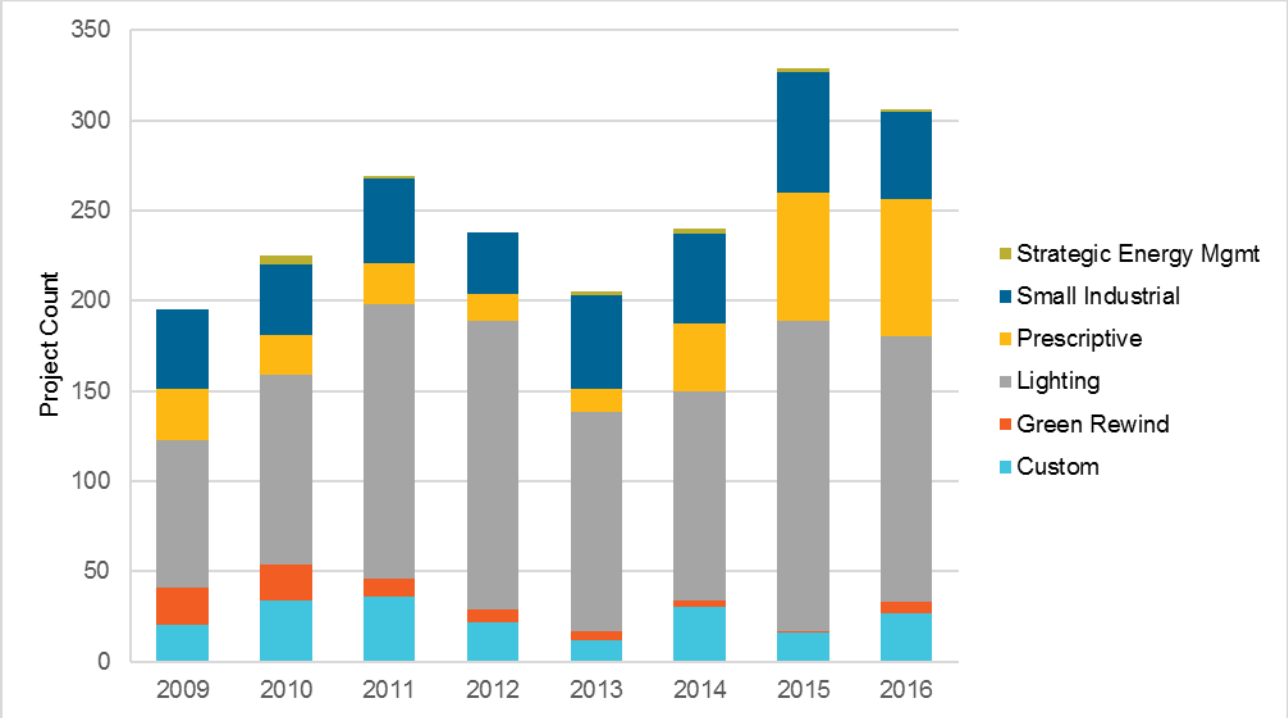
**Figure 4**: Lighting control measures from 2009 – 2016 (working kWh)




Another aspect of lighting savings is controls. Figure 4 examines the level and mix of savings from different lighting controls technologies. As LED technology increased in adoption, the program was predicting installations of custom controls, which can include controls embedded into fixtures, would increase proportionally. Although the program surfaced more custom controls savings, custom controls have not increased in proportion to LEDs. In the absence of deeper research, staff believe that this may occur when the incremental energy and dollar savings gained from adding controls is less financially compelling.

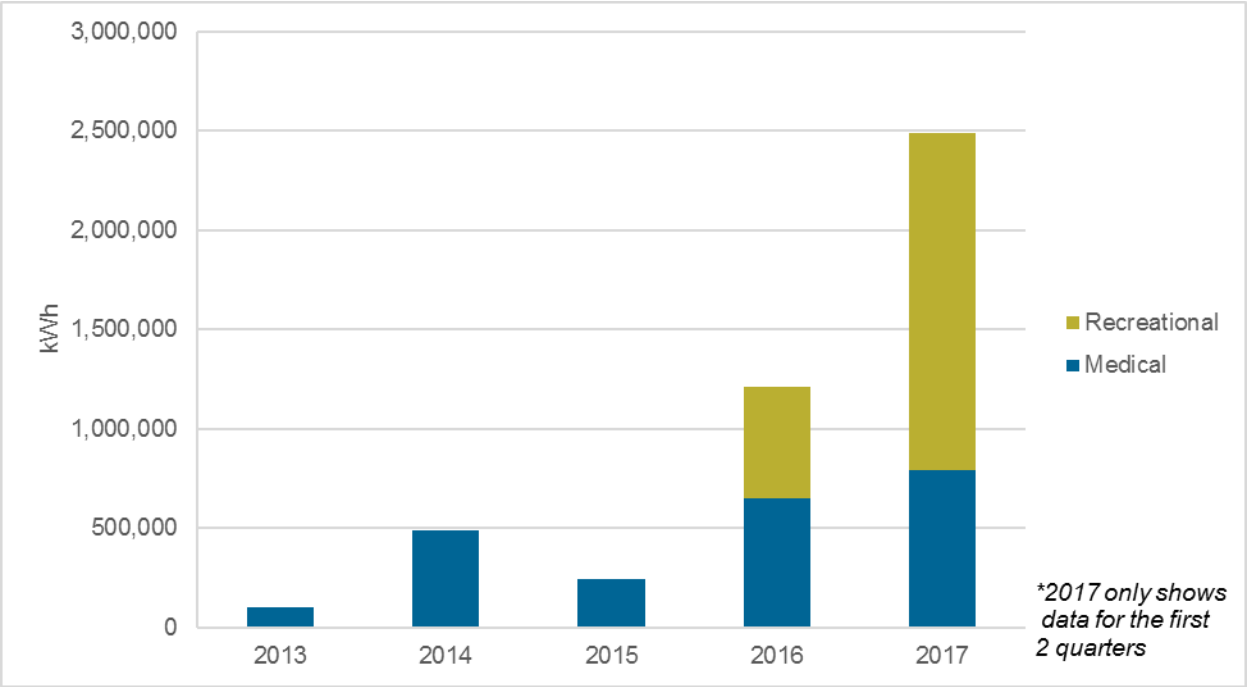
*Program engagement*

**Figure 5**: Customer's first project engagement




With the strategic goal of expanding participation to new, smaller customers, the program examined how new participants first entered in the program. The design was setup to engage new customers with account managers, custom PDCs. However, after analyzing past participation data, a customer is most likely to first engage in the standard track, specifically in lighting. This finding will be part of a larger analysis and will support future program design strategies to expand participation in the most cost-effective manner.

**Figure 6:** Cannabis/Indoor Agriculture savings from 2013 – 2016 (working kWh)



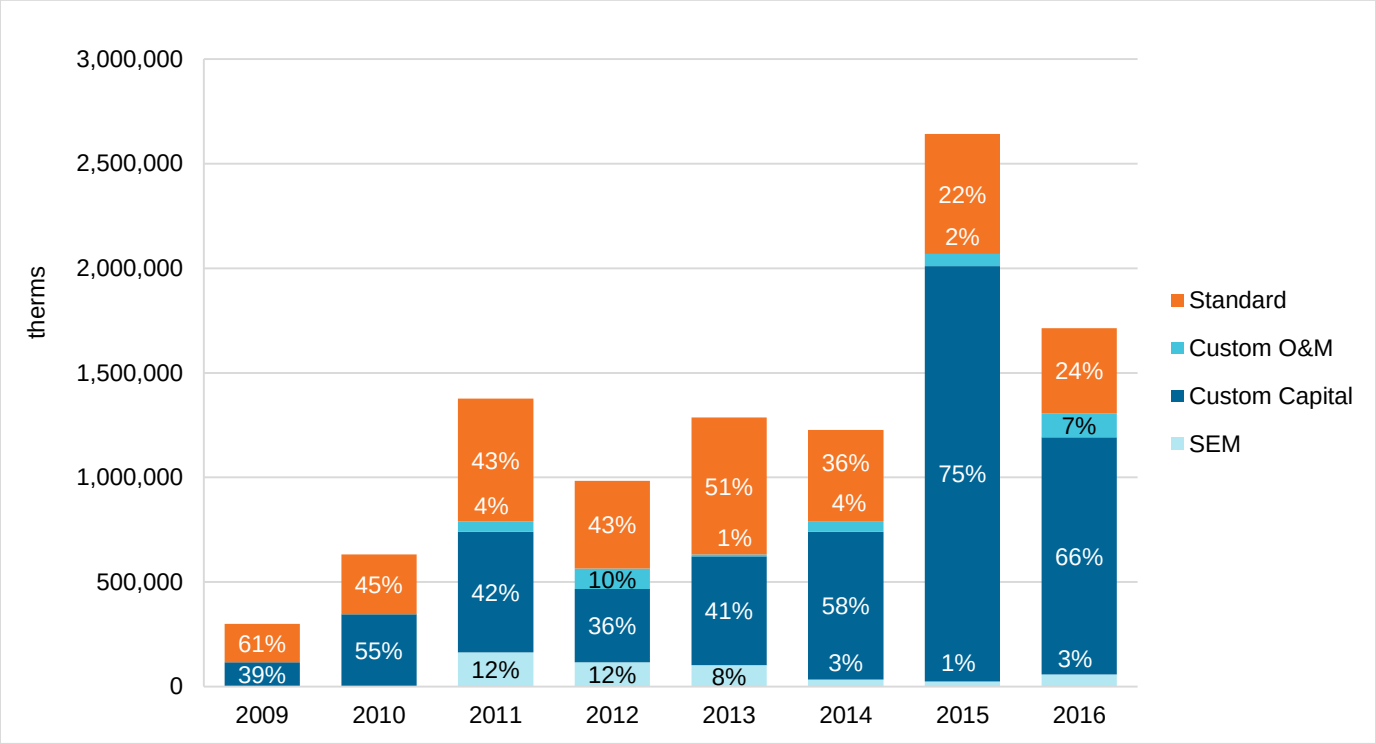

The single biggest change for Production Efficiency has been the addition of the legalized cannabis industry to the program portfolio. Figure 6 shows the growth in savings from the cannabis market.

Energy Trust began serving medical facilities in May 2013 with three completed projects. Larger savings opportunity arrived with the legalization of recreational/adult-use cannabis in November 2015. Energy Trust completed 17 projects in 2016 when the number of licensed facilities was small. To illustrate the rapid growth of this market segment, Figure 6 includes data through the second quarter of 2017 for 19 completed projects. An additional 28 projects and 10 million kilowatt-hours of savings are forecast to complete in 2017, for customers of both electric utilities.

The majority of project savings are for process lighting, primarily LEDs. Projects are often implemented in phases as growers test lighting designs and strategies in the various stages of plant cultivation, and across plant strains. Through a close collaboration with growers, Energy Trust is developing more expertise around lighting design and growing strategies for cannabis. There are also non-lighting opportunities – HVAC, dehumidification and odor control – to expand savings further.

Oregon's cannabis industry is in start-up mode and the program anticipates that dynamic market will experience consolidation over the next few years. Energy Trust is tracking the rate of new grower licenses as one way to refine forecasts.

**Figure 7**: Gas sources of savings from 2009 – 2016 (working therms)



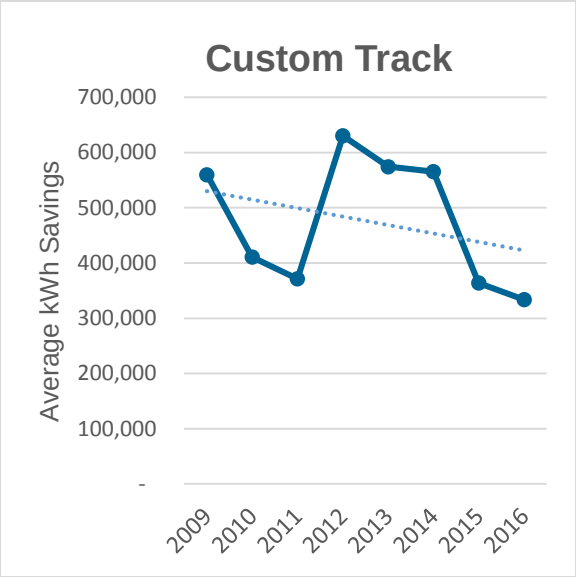

Gas savings in the program vary widely year to year as shown in Figure 7[1]. Compared to electric projects, the number of gas projects is low—under 100. And because projects are often large and complex, one project may represent the majority of the Production Efficiency annual gas savings goal. The program achieves more predictable but smaller gas savings through standard industrial equipment and greenhouses.

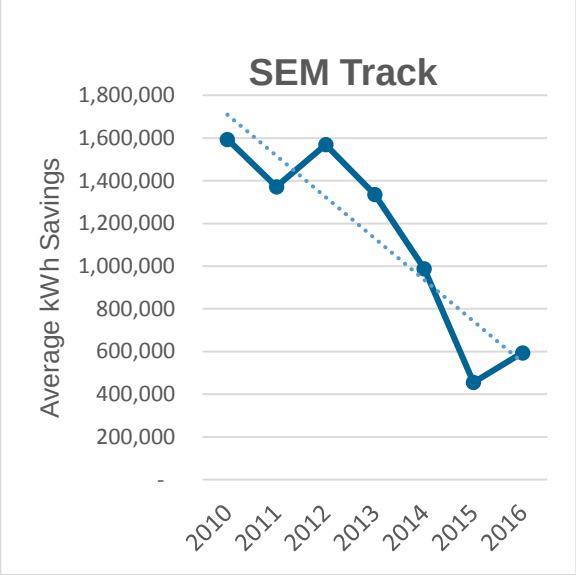
[1] Note, Energy Trust does not serve customers who receive their natural gas through transportation rates.

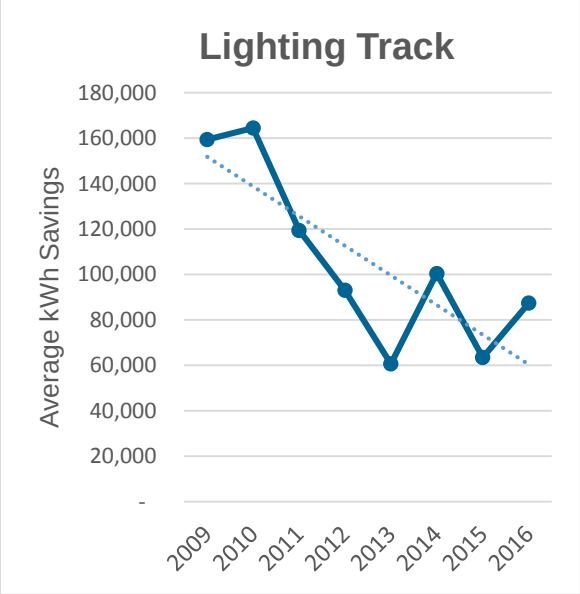
The next sets of charts outline the average savings per project from the various market pathways in the program. Overall the number of completed projects has grown significantly as shown in Figures 10 and 11, while the savings per project has been variable, as shown on Figures 8 and 9.

Figure 8 illustrates that electric savings per project have declined in three of four key program tracks. The exception is the standard track, where savings per project grew from 2009 to 2016 due to targeting more small to medium sized customers. However, because the portion of standard track saving is smaller than the other tracks (Figure 2), this growth in saving per project cannot make up for the decrease in savings across the other tracks.

**Figure 8**: Electric average project size by track from 2009 – 2016 (working kWh)



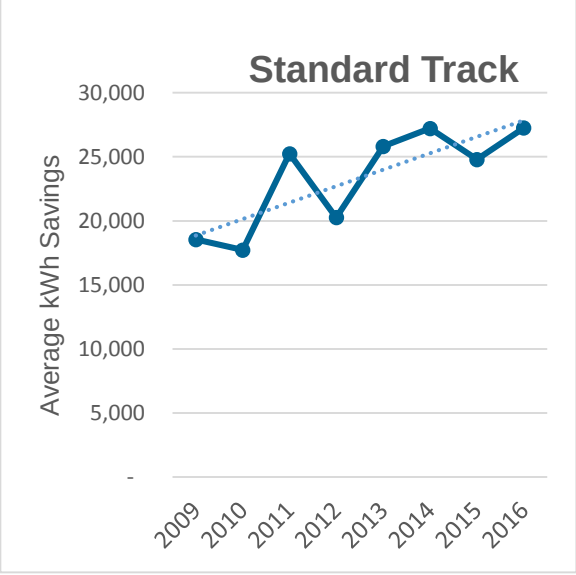



Figure 9 illustrates the changes in average project size over time for gas. The gas trends are not as conclusive as the electric. Average custom track gas savings are impacted by large projects, because of the relatively small number of gas projects completed in a given year compared to electric projects. This was the case in 2015 when one exceptionally large gas project accounted for 62% of total program gas savings, resulting in a large spike in average custom track gas savings for that year.

The high average SEM gas savings in 2011 and 2012 were due to the completion of exceptionally large O&M projects. Similarly, in the standard track, there were abnormally high savings in greenhouse high efficiency condensing boilers that shifted the average project size for 2013.

**Figure 9**: Gas average project size by track from 2009 – 2016 (working therms)

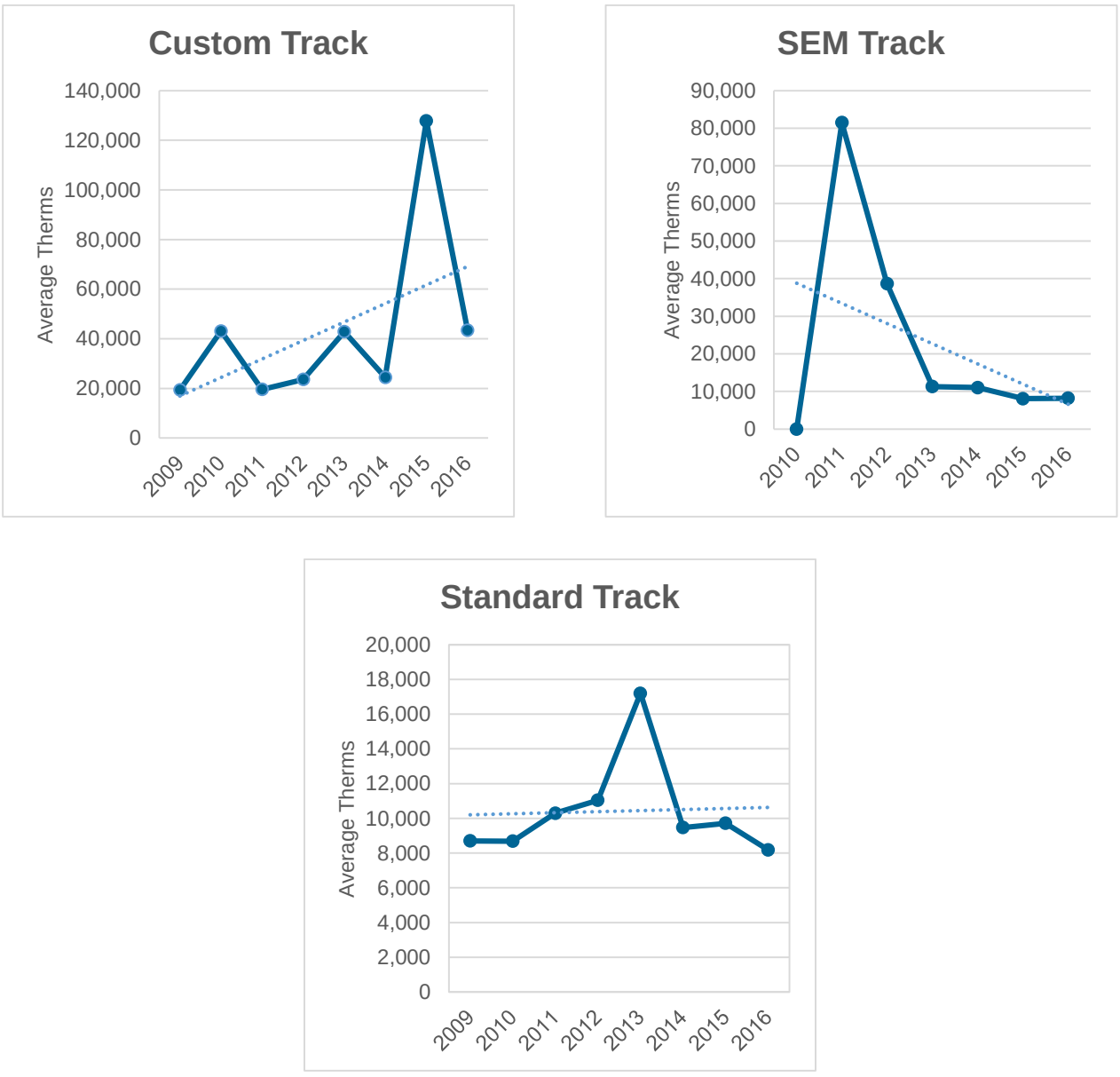


Figure 10 shows total Production Efficiency project volumes since 2009. Between 2014 and 2015, the program had the largest project volume increase of 27 percent.

Figure 11 shows the overall trend of more projects in all key areas of the program. Lighting and standard upgrades have seen the most significant growth. The number of standard projects has increased steadily every year, with the exception of a small dip in 2011. The number of lighting projects more than doubled between 2009 and 2011, remained relatively level between 2011 and 2014, then increased by 67 percent in 2015.

An impact of higher project volume is the correlating increase in the number of technical studies required to reach program savings goals. This shows up as increases in delivery and incentive costs (Figures 16 and 19).

In 2016, SEM engagements returned to a more typical level after three years of significantly higher enrollment which would show up in 2017. Staff believe that the program has largely saturated the market for new, first-year SEM enrollments. Continuous SEM, introduced in 2016, will establish a path for customers of all sizes to engage in SEM over a longer period.

**Figure 10**: Count of completed Production Efficiency projects from 2009 - 2016

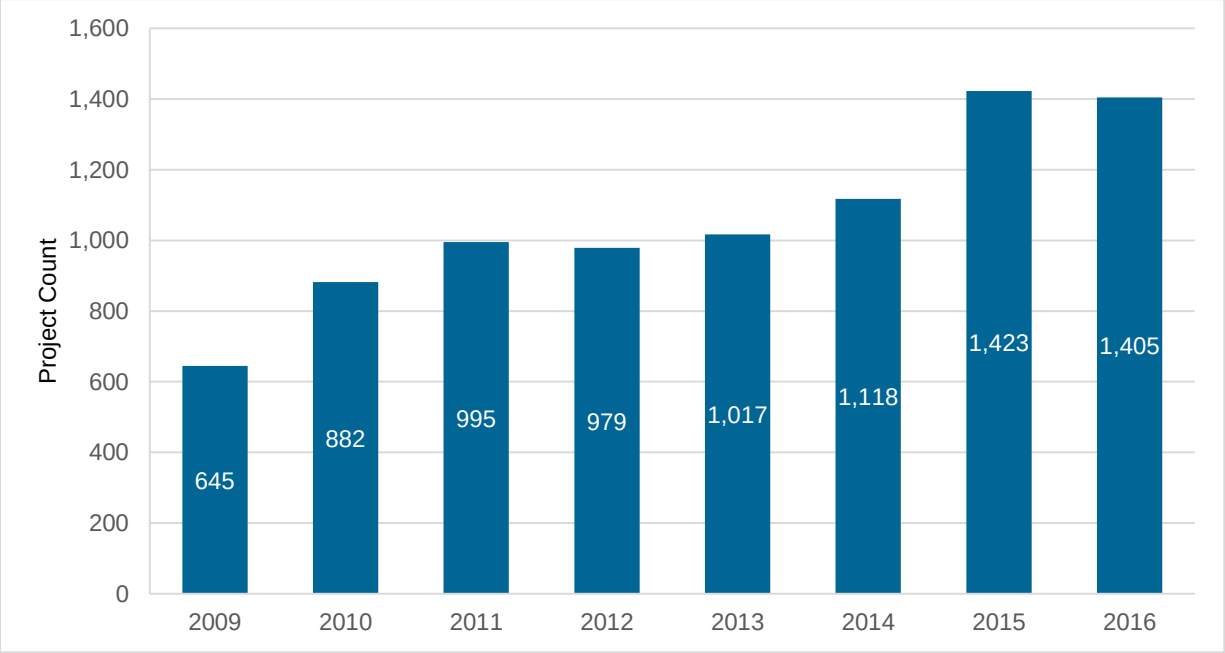
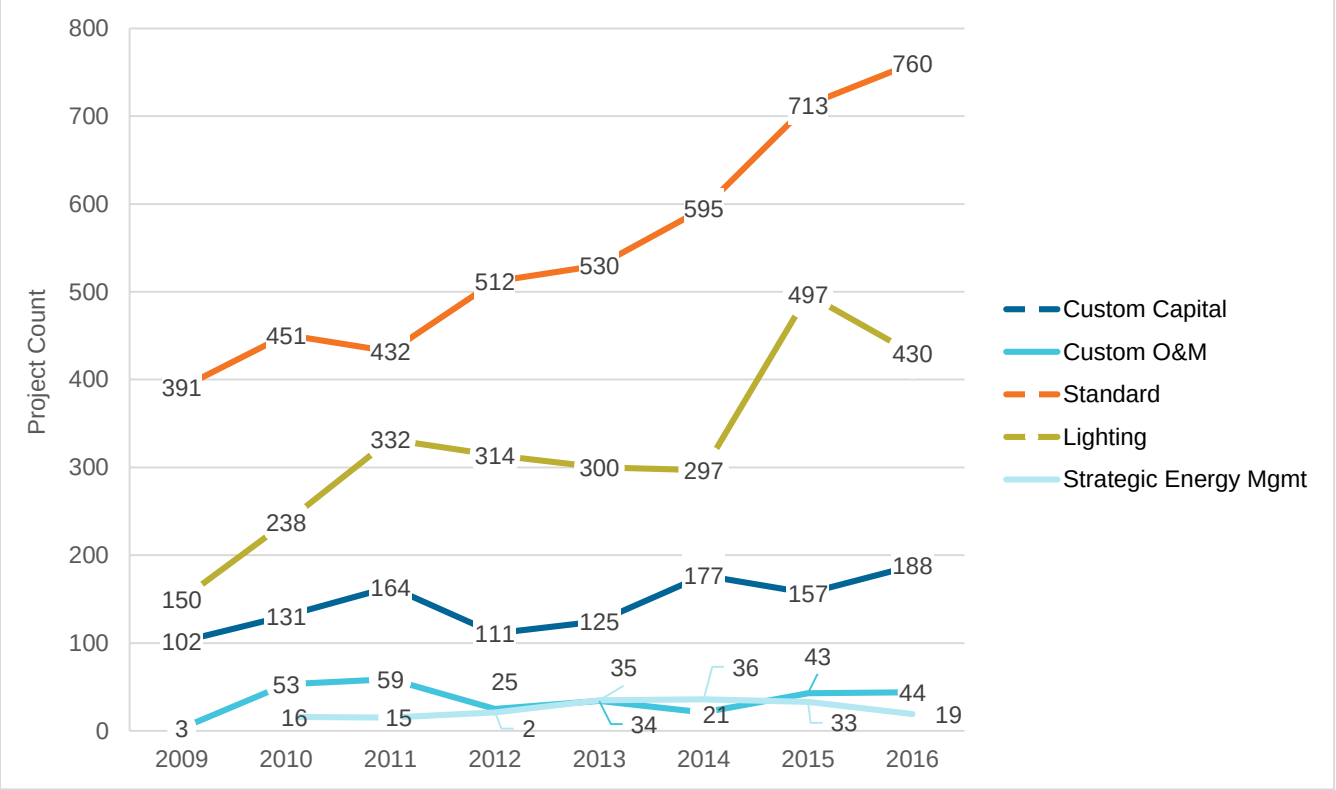


**Figure 11**: Project counts by sources of savings from 2009 – 2016



## III. Systems

As the program began serving more small and medium customers, staff has seen an increase in savings in the standard track and has created new measures such as the cooling tower fan VFD, welders, and refrigeration measures, controls and high speed doors to reach more customers in specific markets. Lighting is integrated into all industrial and agriculture sites; therefore, it is a well-represented system type. As shown in Figure 2, Lighting represented 30 percent of savings in 2016. As the indoor agriculture/cannabis market grows (shown in Figure 6), lighting will continue to be one of the largest system savings in the program portfolio. The following charts (Figures 12 and 13) show the industrial systems that produced the most savings in 2016.

**Figure 12**: Electric savings from measures associated with top 10 industrial systems in 2016 (working kWh)

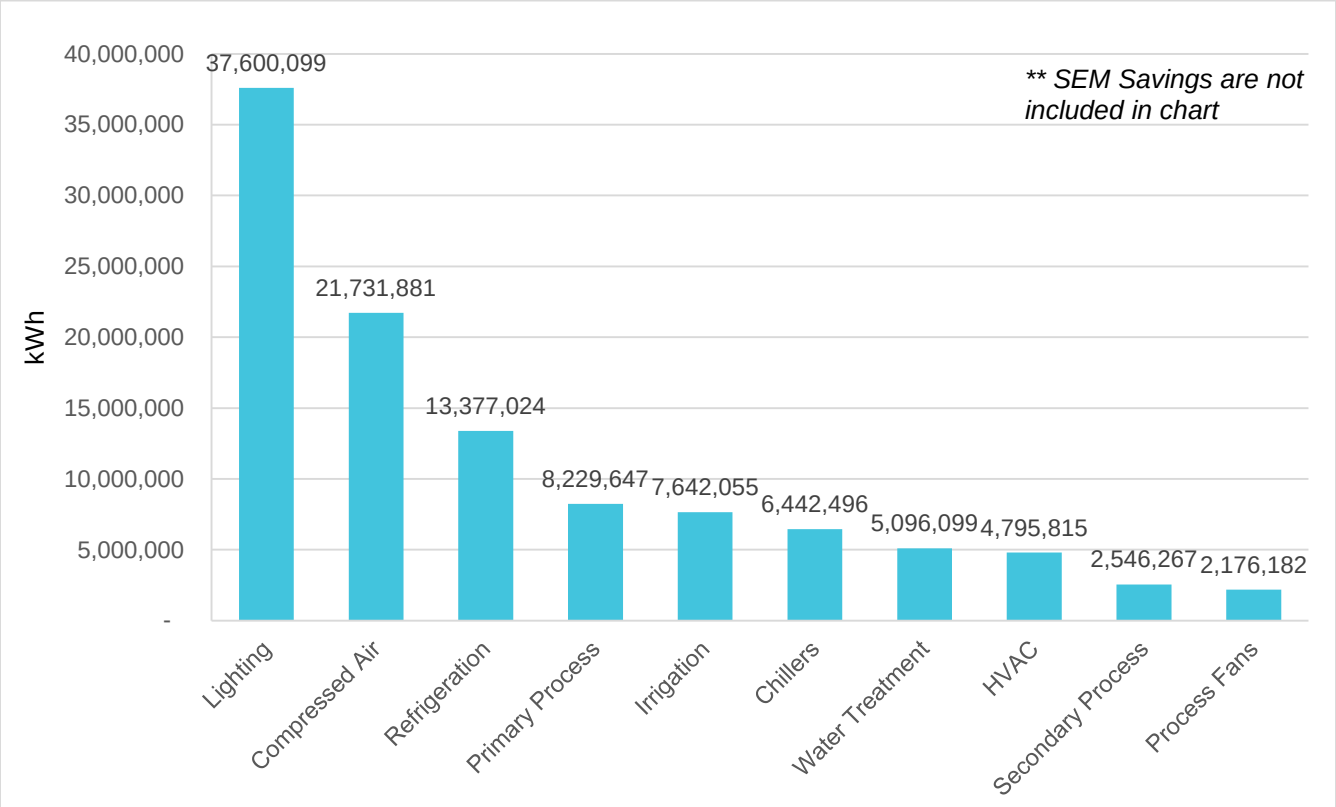
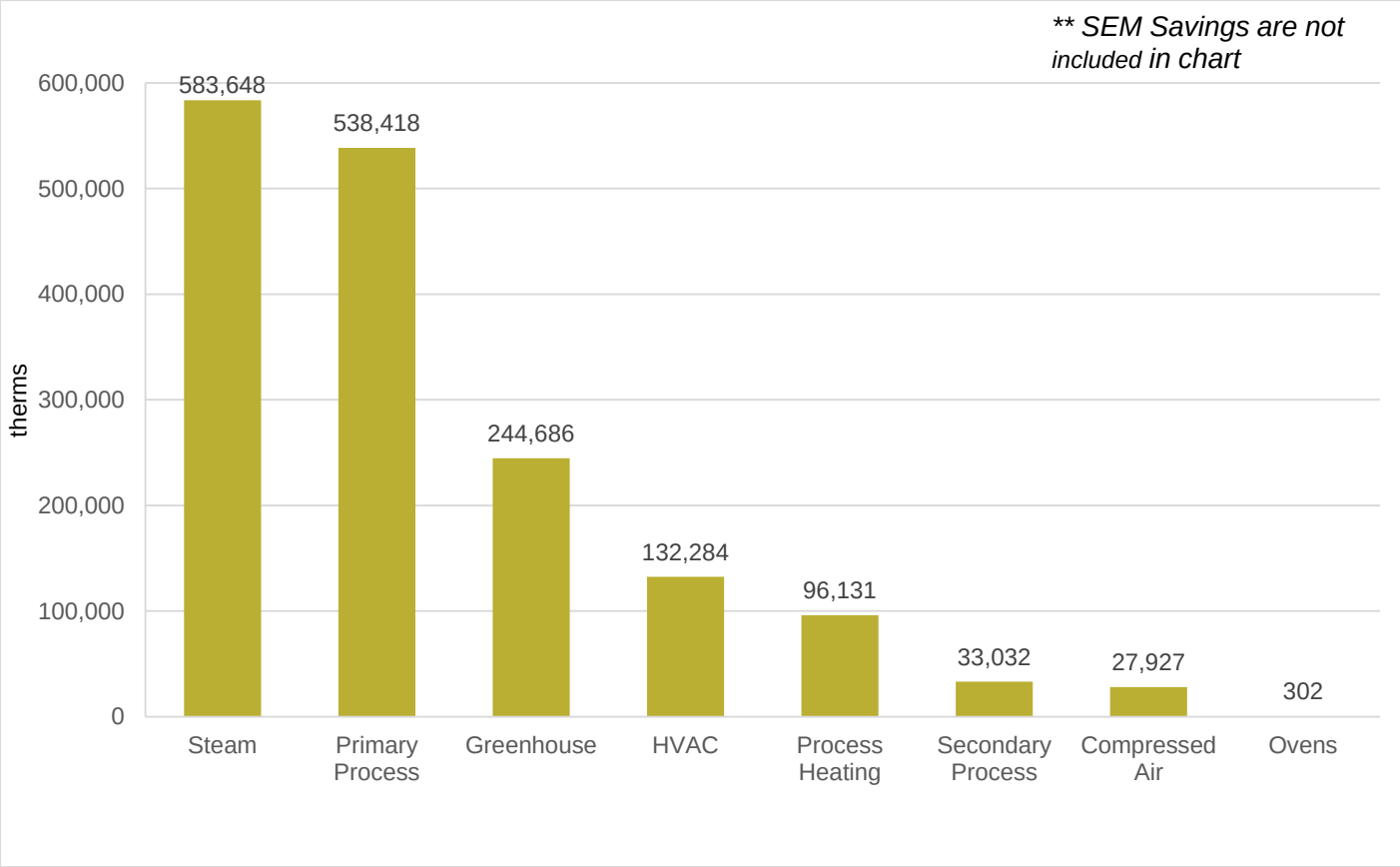


**Figure 13**: Gas savings from measures associated with top 8 industrial systems in 2016 (working therms)




Steam, primary process and greenhouse contributed to over 75 percent of the program savings. The program continues to work with large custom processes, specifically upgrades on steam boilers, but also have increased outreach and savings in the standard track with insulation for steam pipes systems.

Greenhouse continues to be a strong system in gas savings and the program is continually adding new measures, such as greenhouse condensing unit heaters at the end of 2015, to continually drive deeper savings in the system.

## IV. Program Costs

The following charts show historic cash incentives, delivery and service incentives per kilowatt-hour or therm.

**Figure 14**: Electric cash incentives 2009 - 2016 ($/working kWh)

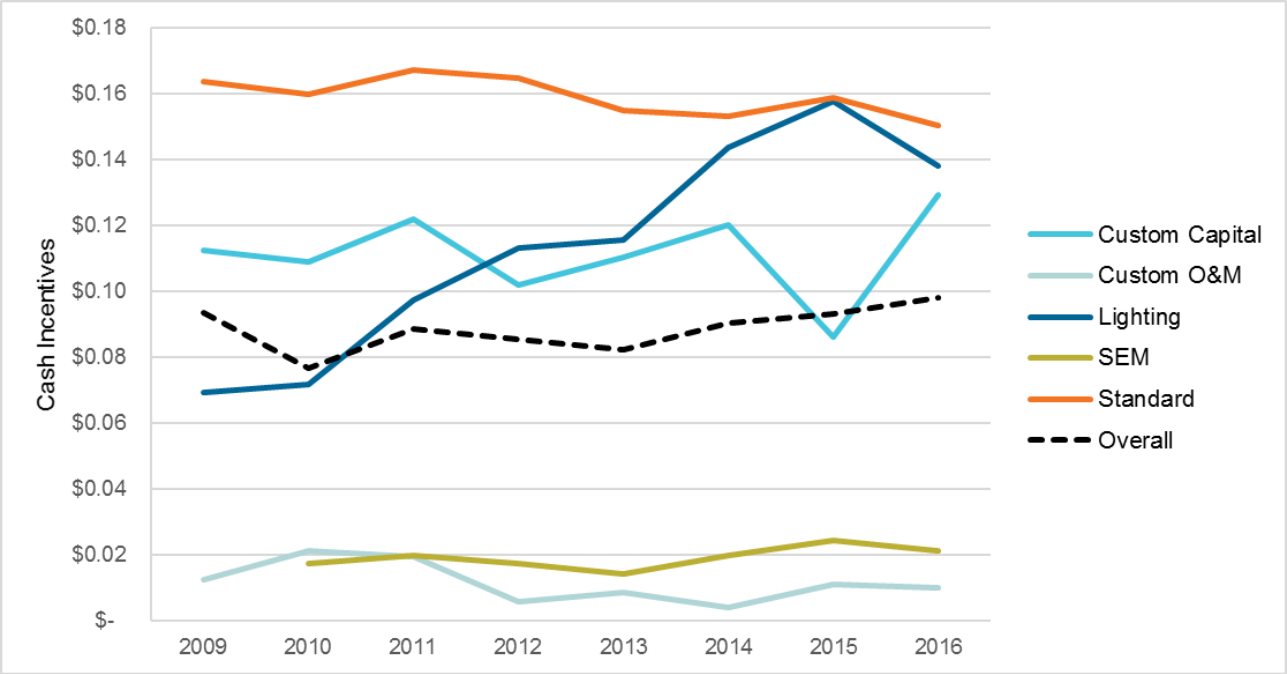



Figure 14 shows the average incentive costs per kilowatt-hour from 2009 to 2016 for all program tracks. The standard industrial and agriculture has stayed relatively stable with a few new measures entering the track.

Lighting had increased somewhat as LEDs have become dominant in the market, but seems to be declining again as product costs begin to drop. This is being offset somewhat by lighting upgrades at cannabis cultivation sites where their high lighting demand is resulting in highly cost-effective projects.

Custom Capital and Custom O&M costs have remained relatively stable over the years. There is a dip in Custom Capital in 2015 due to a number of relatively large, very cost-effective projects completing that year. Custom capital electric incentives are calculated at a dollar per kilowatt-hour rate up to a percent of project cost cap. Large cost effective projects can reduce the overall electric custom capital incentive rate in a given year. Alternatively, if large projects complete at, or close to the incentive cap, the impact can be an increase in the average incentive rate for a given year. This was the case in 2016 when several large custom capital projects completed at close to the $0.25 per kilowatt-hour incentive rate.

SEM costs rose after 2013, corresponding to the introduction of the first-year SEM offering to small/medium sites. Costs peaked in 2015 when Energy Trust launched regional cohorts.

**Figure 15**: Gas cash incentives from 2009 - 2016 ($/working therms)

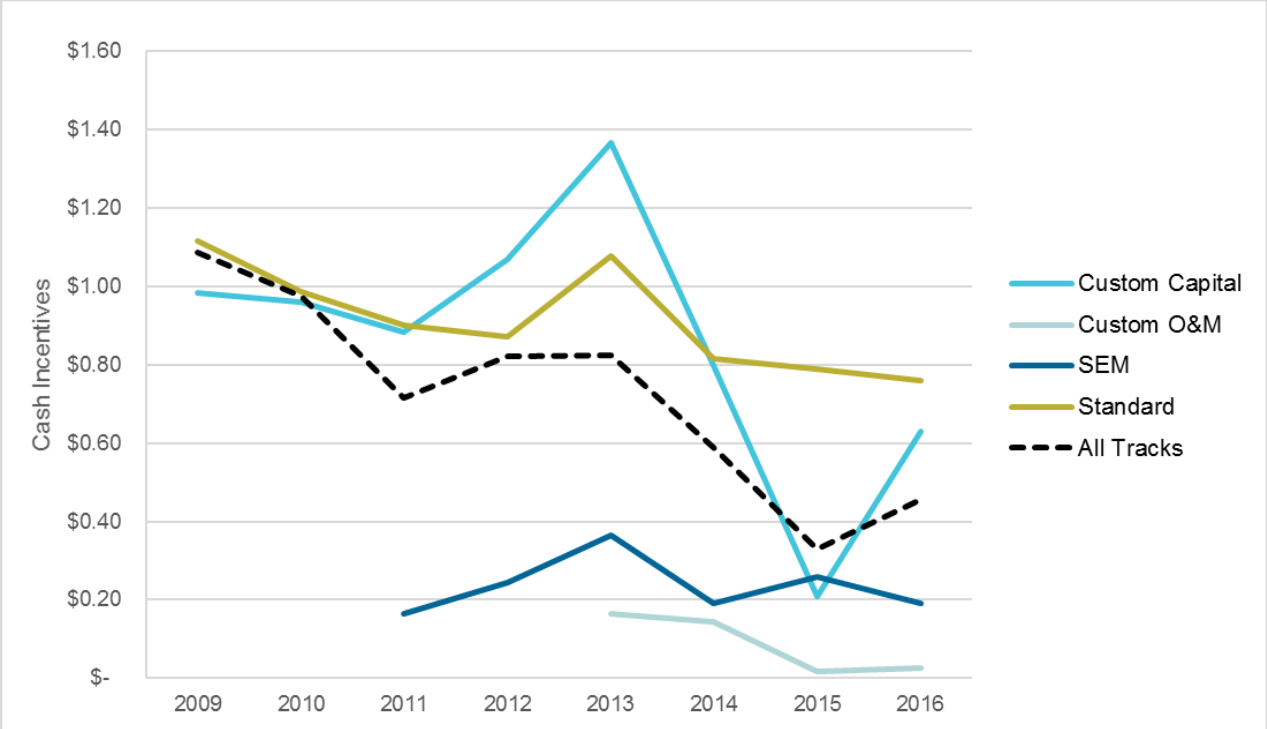
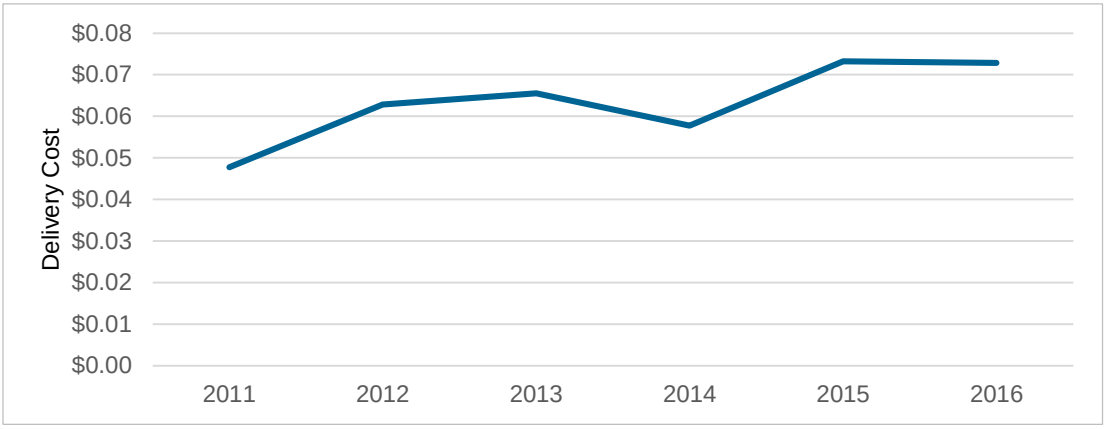



Figure 15 shows that standard track incentives have remained relatively stable due to the majority of the savings coming from standard measures with set prescriptive incentive levels. Custom capital gas incentives are calculated at a dollar per therm rate up to a percent of project cost cap. Large cost-effective projects can reduce the overall custom capital gas incentive rate in a given year, which was the case in 2015, with the completion of one very large gas project which accounted for approximately 60 percent gas savings. Alternatively, if large projects complete at, or close to the incentive cap, the impact can be an increase in the average incentive rate for a given year. This was the case in 2013 when two large custom gas projects completed at greater than $1.00 per therm.

**Figure 16**: Electric delivery run-rates per electricity savings ($/working kWh)



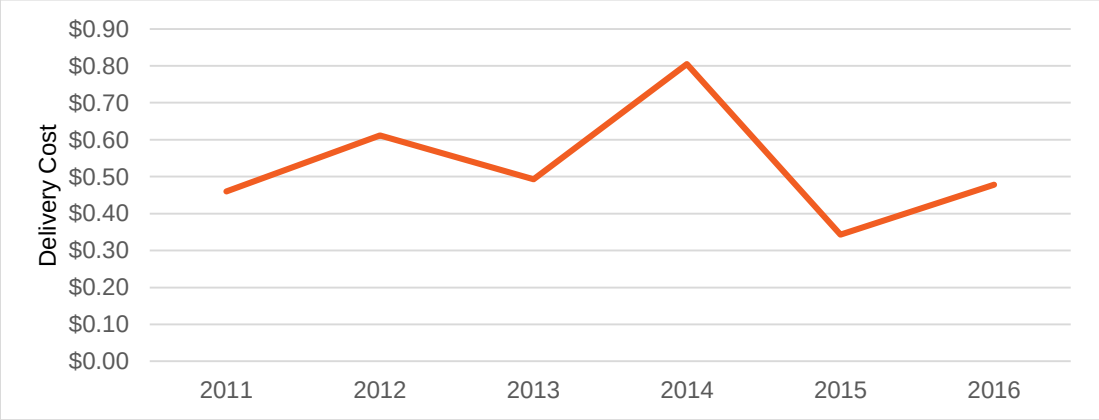

Figures 16 and 17 show average delivery run-rates, costs per kilowatt-hour and therm.

Since the program began working with small to medium customers in 2015, staff have seen an increase in program delivery costs. The program also had a strategic goal of serving businesses that we had not reached before, many of which were in areas outside the Portland metro area. The program was successful in expanding participation in central and eastern Oregon in 2015 and 2016, but this resulted in an increase in delivery costs.

Several factors contribute to higher delivery costs to serve small to medium sites in the non-metro area:

- Travel costs for contractors to reach new customers
- Lower savings per site
- Rising costs for contracted services, overall
- Lower project conversion rates from outreach to participation among small and medium customers

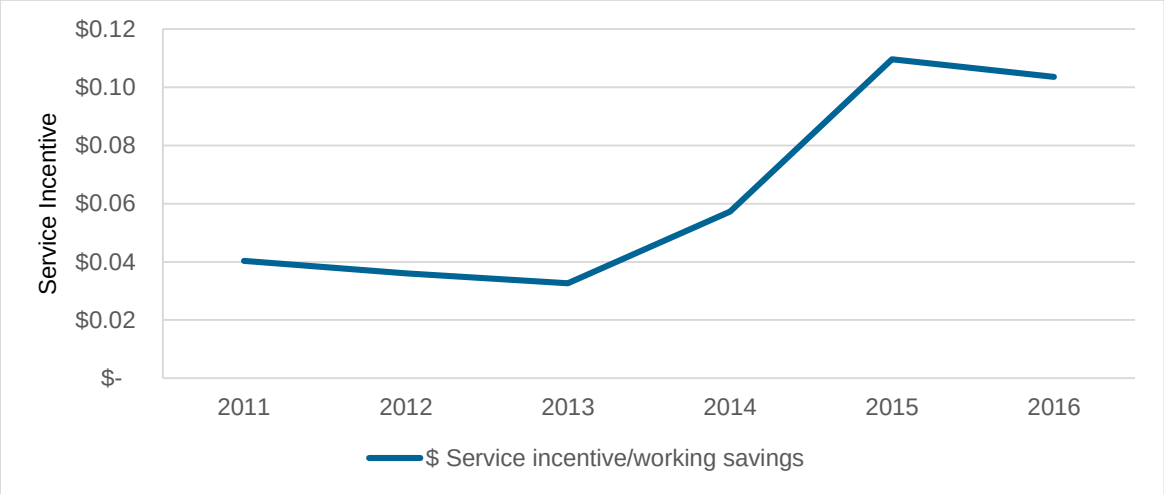
**Figure 17**: Gas delivery run-rates per gas savings ($/working therm)




As shown throughout the gas trends – gas savings are variable, and the delivery rate is less connected to program design than the electric delivery analysis.

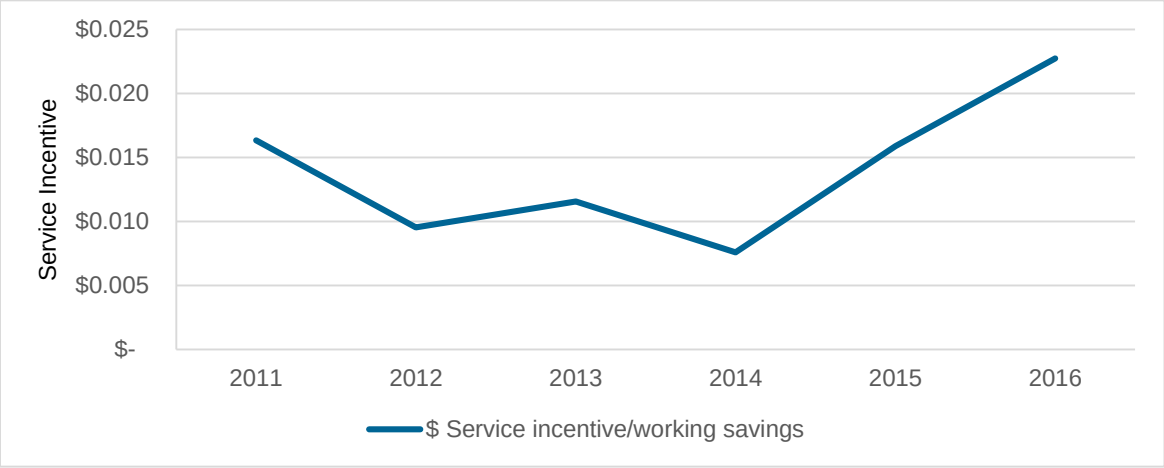
Figures 18 through 20 show the cost of service incentives. Service incentives for the custom and SEM tracks are incentives paid directly to either the Allied Technical Assistance Contractors (ATAC) for completing a technical analysis study (TAS) for a custom study, or to SEM Coaches delivering SEM services to customers.

**Figure 18**: SEM coach service incentive run rates per electricity savings ($/working kWh)



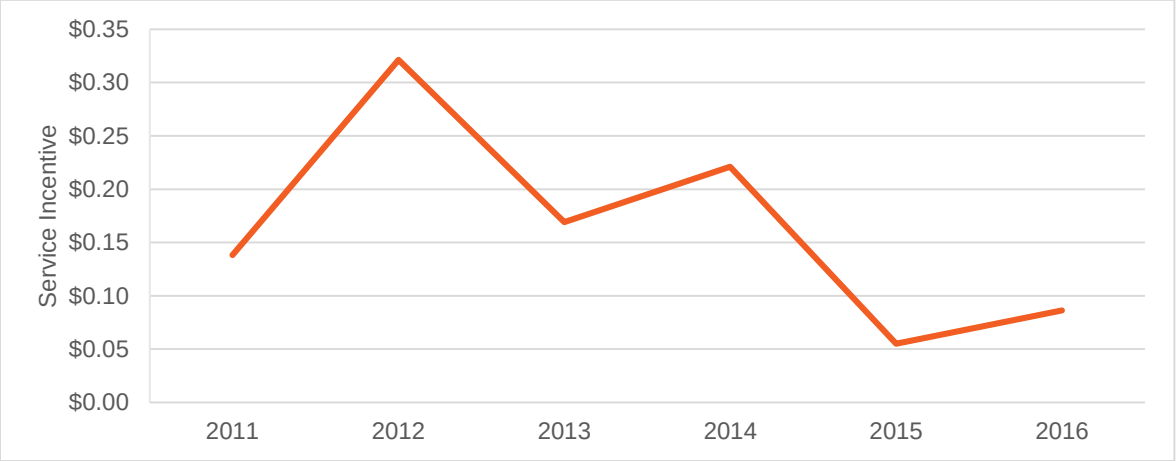

For electric savings shown in Figures 18 and 19, there is an increase in service incentives in 2015 and 2016. The cost to deliver electric savings through SEM has increased as the program targeted small to medium size customers with cohorts in multiple regions across Oregon.

**Figure 19**: Custom studies service incentive run-rates per electricity savings ($/working kWh)




For custom, the volume of projects has grown to deliver the same amount of savings since the average project size has reduced. Additionally, as more and more studies are completed for small to medium size customers with smaller projects, staff are seeing more instances where the conversion rate for studies to committed projects is lower, and there has been a higher probability that the project studied will not be cost-effective since the baseload of savings is smaller than for larger customers.

**Figure 20**: All program service incentive run-rates per therm savings ($/working therm)




The program continues to see large cost-effective projects in the gas custom studies, and has focused on increasing project volume to reduce the lumpiness of the program.

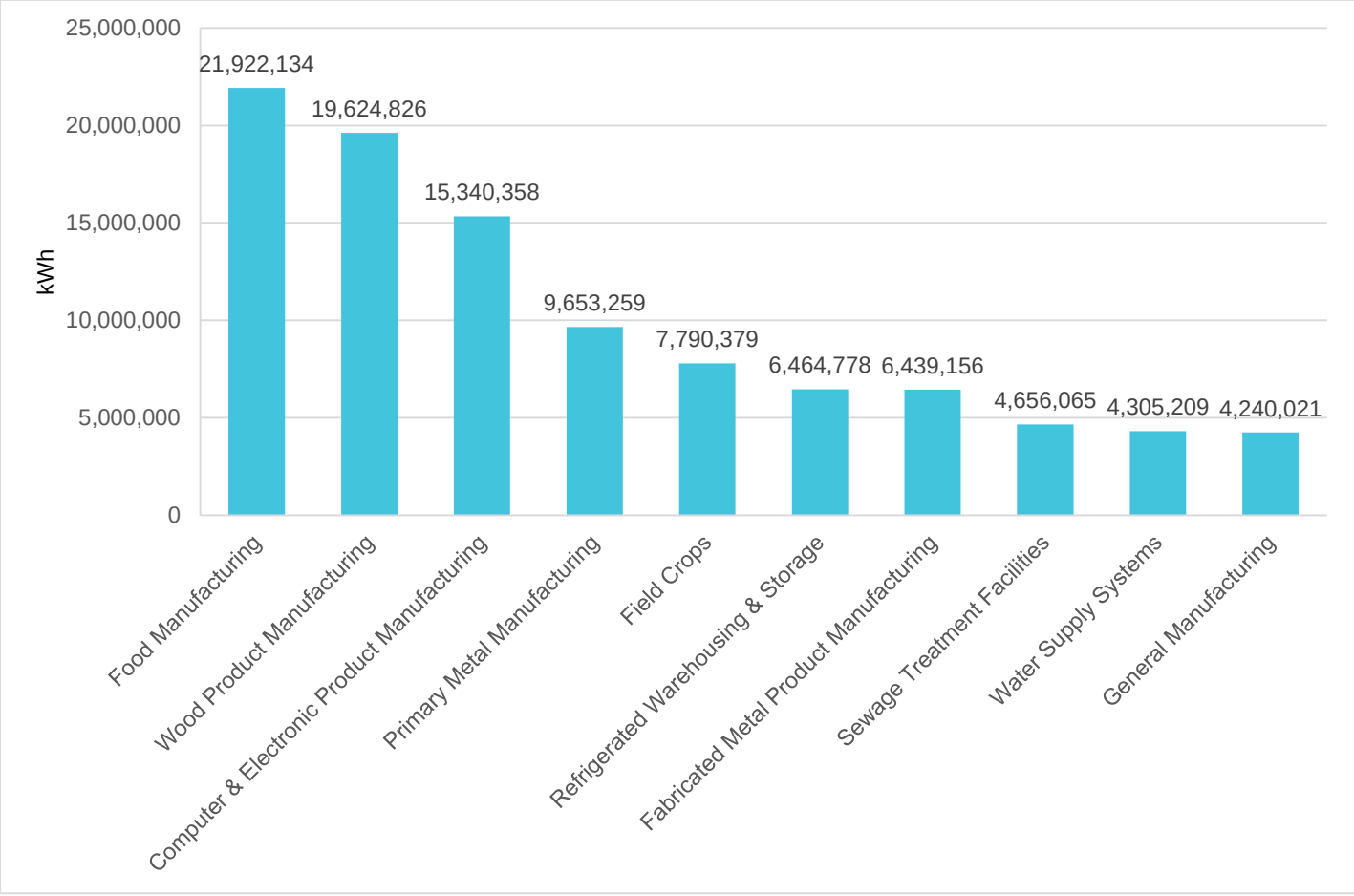
## V. Market Segments

Oregon's manufacturing base is increasingly diverse, and the program has been successful in broadening customer participation in legacy industries such as wood products and food processing and developing markets such as high technology and cannabis across the state.

Market segments are not always a reliable indicator for program participation. Other factors such as corporate culture, competitive climate and executive priorities often have more influence on whether or to what extent a company values investment in energy efficiency as a strategic tool for its business. However, examining the amount of savings provided through top market segments provides insights into the market, and can help staff identify customer groups that may be receptive for greater outreach effort from Energy Trust.

The following charts show the sectors that had the most savings in 2016.

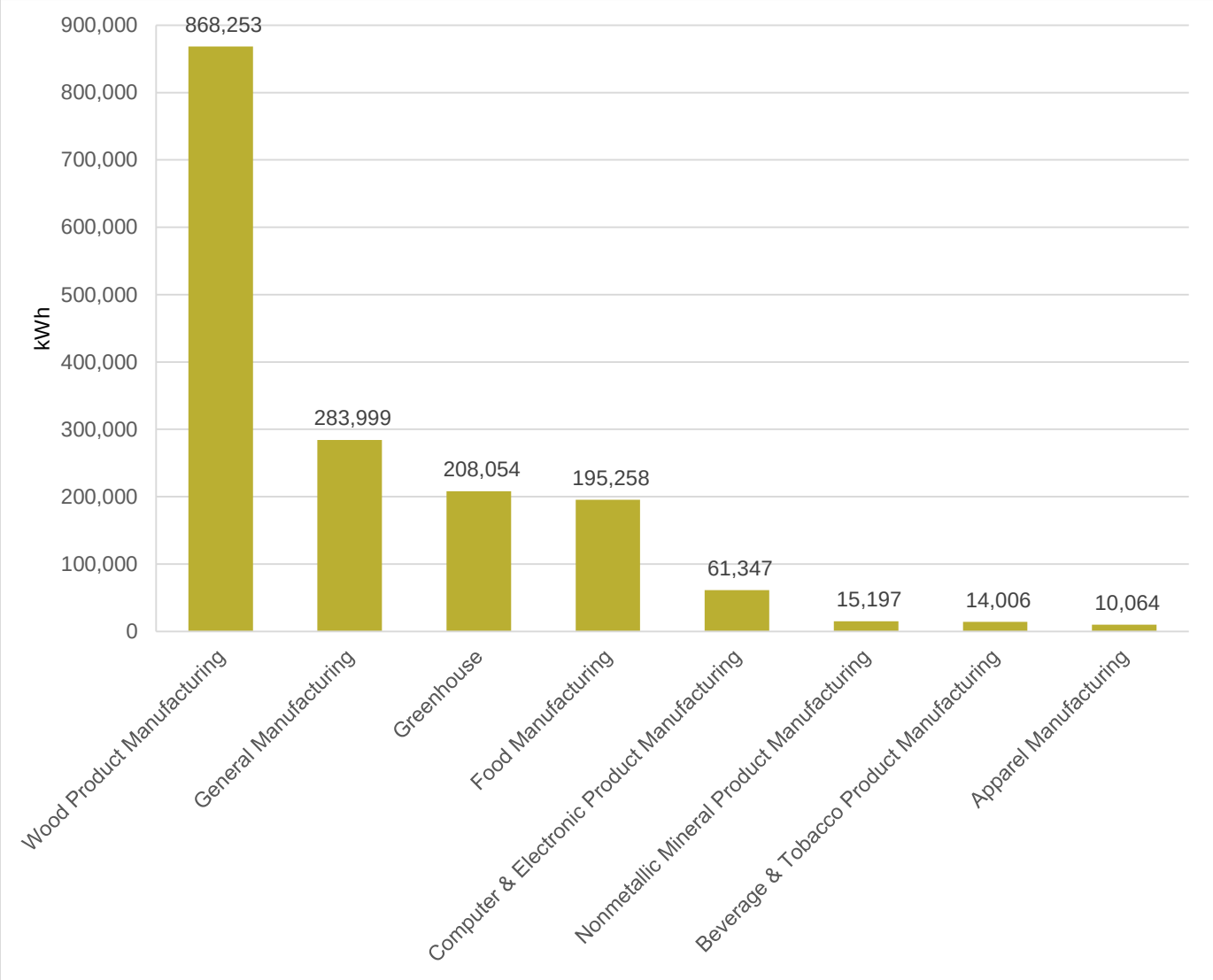
**Figure 21**: Electric savings from top 10 industry types that participated in 2016 (working kWh)




In 2016, the top three producer-types represented approximately 45 percent of all savings. Food processing and wood products continue to be strong Oregon industries. Many of Oregon's leading companies in these two segments have realized the value of investments in energy efficiency, deeply.

The high tech industry has long been recognized as the industry with the greatest electric savings potential, yet the program had difficulty realizing this segment's potential in the early years of the program. More recently, staff have found effective ways to engage these customers and participation from high-tech sites and the segment continues to be one of the largest contributors in 2016.

**Figure 22**: Gas savings from top 8 industry types that participated in 2016 (working therms)




In 2016, the top three producer-types represented almost 80 percent of all gas savings, and Wood Products was 50 percent of all savings. Among standard incentives, greenhouse projects continue to be a strong market for the program.

As the program has matured from 2009 to 2016, our largest markets continue to participate and provide large portions of savings to the program. As we engage more and more with these markets, we see the contributions shift and diversification of the market segments.

Figures 23 and 24 provide a visual perspective on the top markets for Production Efficiency and how they have change from 2009 to 2016. Paper manufacturing, which as a large market segment in 2016, is no longer toward the top, and high tech markets have continued to be in the largest electric markets for the program. Municipal water and wastewater have also become top markets. These charts demonstrate the changing landscape of Oregon manufacturing, as well as the staff's progress in diversifying the program portfolio.

**Figure 23**: 2016 Top Electric Markets

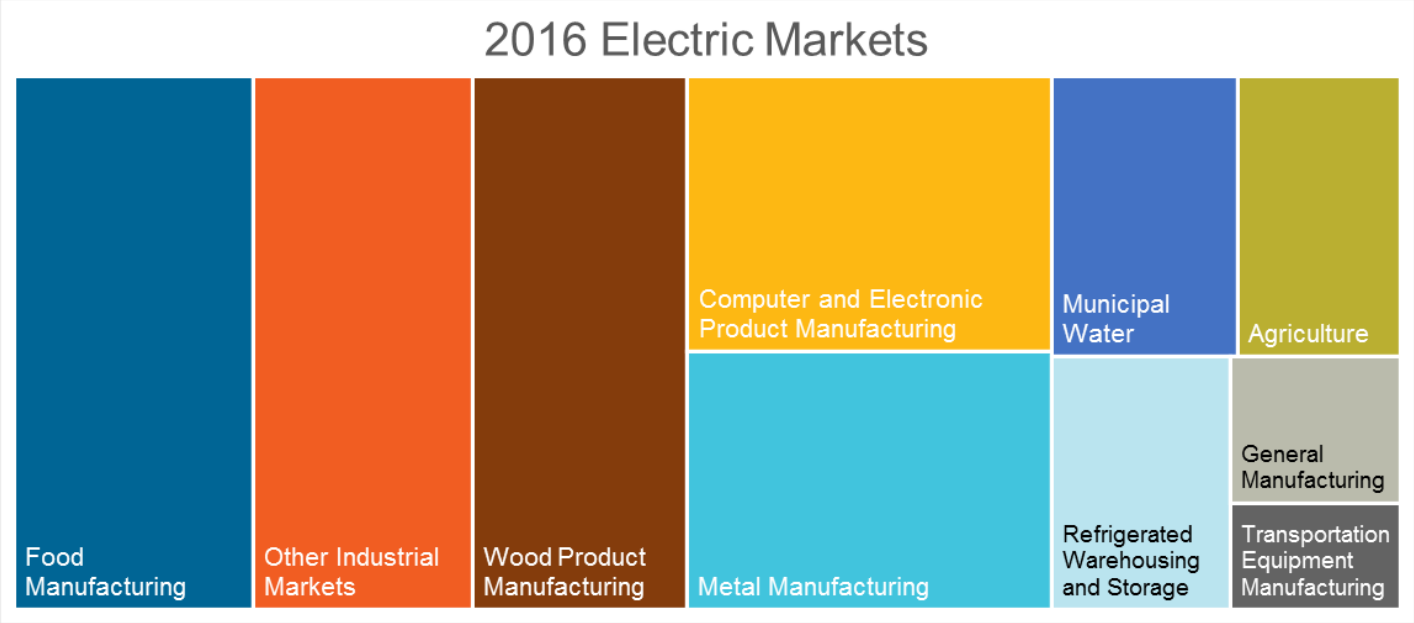
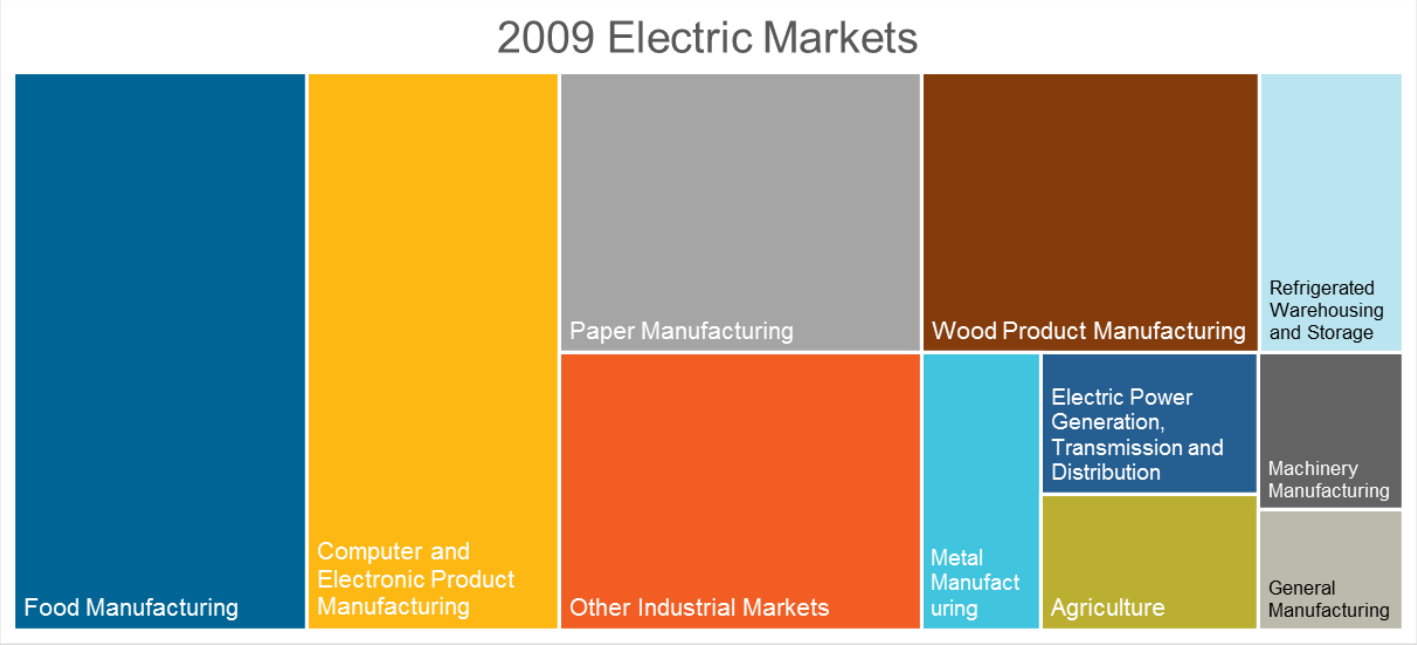



**Figure 24**: 2009 Top Electric Markets



Figures 25 and 26 show the same visual representation of top markets for gas where we see less diversification of market segments. Between 2009 and 2016, wood products and greenhouse are the largest markets for gas savings.

**Figure 25**: 2016 Top Gas Markets

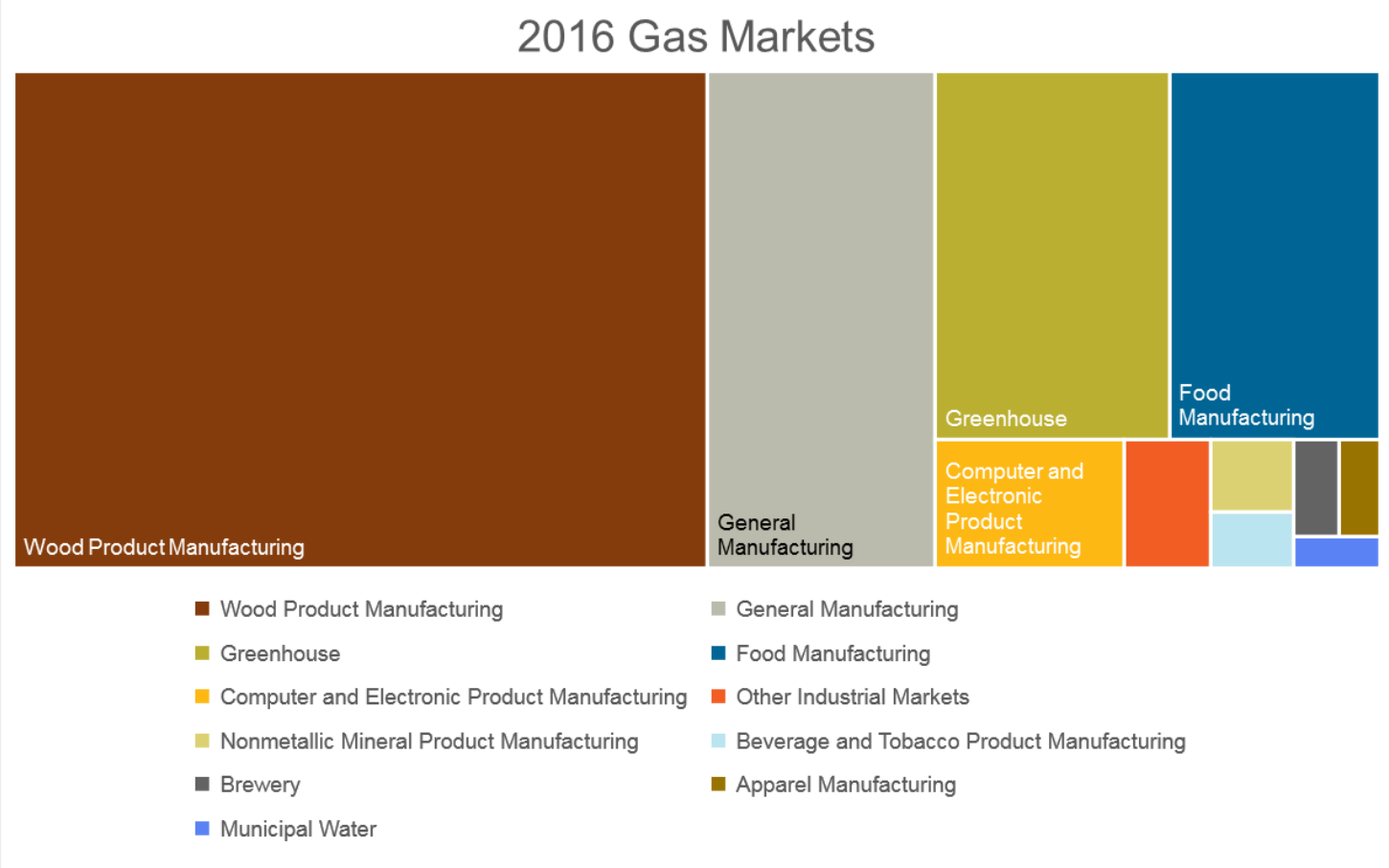


**Figure 26**: 2009 Top Gas Markets