cross-promoting each other's programs. Because of these differences, it may not be possible to extrapolate the experience of Envision Charlotte participants to the larger population of SEiO participants.[3]

The gross annual savings from the program are summarized in Table 1-1. While SEN participants save an average of 5.0% annually through SEiO, we were not able to detect statistically significant savings for non-SEN participants after accounting for savings that Duke Energy has claimed through other energy efficiency programs.[4] Savings are higher amongst customers who have reported engaging with the SEiO's building operator campaigns, but the high number of buildings that have not reported implementing campaigns does limit the ability to detect savings amongst those customers who are using the program's services (because they are still considered participants, we have included these buildings that have not reported campaign activity in our billing analysis, which introduces more noise as we try to isolate savings from billing data). It should also be noted that all groups of customers save energy overall before we deduct savings that have been claimed through other energy efficiency programs offered by Duke Energy. To the extent that SEiO is helping motivate participants to pursue savings through Duke Energy's rebate programs, our estimates under-estimate the effect of the program.

[3] While not related to program implementation, another difference was that SEN buildings also had higher and more stable occupancy rates than non-SEN buildings.

[4] Our ability to detect a trend between tenure and savings for non-SEN pilot buildings is limited by the fact that non-SEN buildings in general have participated for a shorter period of time than have SEN pilot buildings. It is possible that as time goes on, the relationship between tenure and savings for non-SEN pilot buildings may become meaningful.

Using self-reported data from building operators and coaches, we estimated a free-ridership rate of 9.5%. This resulted in a net-to-gross ratio of 0.905 that we applied to all buildings that achieved measurable savings through the program to estimate net impacts. Table 1-1 shows savings by stratum, while Table 1-2 shows savings by building size.

Table 1-1. Summary of Annual Gross Savings by Stratum

Stratum			N[a]	Average Annual Change in Energy Consumption Before Adjusting for Other EE Savings (%)[b]	Average Annual Change in Consumption After Adjusting for Other EE Savings (%)[b]	Average Annual Change in Consumption After Adjusting for Other EE Savings (%)[b] Annual Change in Consumption After Adjusting for Other EE Savings [b]		Net Annual Change in Consumption After Adjusting for Other EE Savings and Free-ridership [c]	
						%	kWH	%	kWH
Non-SEN Pilot Participants	Large	Engaged (#1)	44	-1.3%	-0.6%	-0.3% (90% Prediction Interval: -1.7% to +1.4%)	-1,039,628	0.0%	-22
		Non-reporting (#2)	13	-3.0%	+1.6%				
	Small	Engaged (#3)	59	-2.1%	-0.4%				
		Non-reporting (#4)	33	-8.0%	-5.4%				
SEN Pilot Participants	Large & Small	Engaged (#5)	19	-6.4%	-5.2%	-5.0% (90% Prediction Interval: -8.1% to -1.5%)	-14,684,033	-4.4%	-13,007,235 [a]
		Non-reporting (#6)	10	-6.0%	-4.6%				

a. The number of buildings shown here includes those buildings that were excluded from the analysis because they did not have at least 12 months of pre-enrollment period data.
b. Negative values indicate savings.
c. Net-to-gross ratio of 0.905 was applied only to sites with measurable savings through the program. If a building's consumption increased, we did not apply a net-to-gross adjustment.

Table 1-2. Summary of Annual Gross Savings by Building Size

Size Group	Billing Analysis N	N[a]	Average Annual Change in Energy Consumption Before Adjusting for Other EE Savings (%)[b]	Average Annual Change in Consumption After Adjusting for Other EE Savings [b]		Net Annual Change in Consumption After Adjusting for Other EE Savings and Free-ridership [c]	
				%	kWH	%	kWH
Large (>=100,000 s.f.)	72	80	-4.5%	-2.6%	-13,990,486	-2.2%	-11,767,407
Small (< 100,000 s.f.)	91	98	-3.6%	-1.9%	-1,733,174	-1.4%	-1,239,850

a. The number of buildings shown here includes those buildings that were excluded from the analysis because they did not have at least 12 months of pre-enrollment period data.
b. Negative values indicate savings.
c. Net-to-gross ratio of 0.905 was applied only to sites with measureable savings through the program. If a building's consumption increased, we did not apply a net-to-gross adjustment.

Our process evaluation sought to explore building operators' and coaches' experience with the program, as well as to better understand trends in terms of participants' engagement with the various services the program offers. Overall, our process evaluation found the following:

- Building owners and coaches are motivated to participate by bill savings and the tools and information that the program provides for implementing efficient maintenance and operations practices. Marketing services and the recognition provided by the program are also important motivators.
- Building operators and coaches are satisfied with program tools, staff, and activities.
  - Satisfaction was highest with the forums and events for building operators and coaches (8.4 on a 0 to 10 scale), although only about half of interviewed operators and coaches had attended these.
  - Overall, satisfaction was also high with the building operator campaigns (7.9), program staff (7.6), program overall (7.3), automated building benchmarking (7.1), and the Smart Energy HQ (7.1).
  - Building operators' and coaches' satisfaction was lowest with energy savings (6.1) and tenant challenges (5.0).
- There is variability in how active participants are in engaging with program campaigns and services.
  - Just over half of building operators had completed eight or more campaigns, while almost one-fifth of operators had not recorded implementing any campaign actions in the Smart Energy HQ by February 2017.
  - Building operator campaign participation increased substantially after program staff conducted a concerted outreach effort in March of 2016, in advance of the first building operator awards dinner. Building operators earned awards based on their level of campaign activity at this dinner, which may have motivated them to complete multiple campaigns in the month leading up to this event. However, there was a large drop-off in operator campaign participation after the March 2016 building operator awards dinner. While this drop-off may have reflected the role of the awards dinner in motivating building operators, changes in engagement staff personnel and communication modes may have also played a role.
- There is variability in how useful building operators found building operator campaigns.
  - Two-thirds of operators rated the usefulness of the campaigns as four or five out of five (very useful).
  - Many operators characterized the information they received through the building operator campaigns as reminders or reinforcements of maintenance and operations activities they should already be doing.
  - When asked how campaigns affected their practices, building operators reported starting or increasing verification or performing other maintenance activities during half of completed campaigns, while not making any changes for the other half of campaigns. How much campaigns influenced operators' behaviors varied more across operators than across campaigns.

  - Overall, the less engaged building operators were not able to articulate specific barriers to implementing operator campaigns, but some mentioned that campaigns were duplicative of what they were already doing or not valuable enough to commit the time and resources needed to complete them.

- Recognition and awards appear to be powerful motivators for building operators.
  - There was a very large spike in campaign participation before the first awards dinner that recognized building operators and coaches for their participation.
  - Building operators and coaches ranked the recognition they received through the program as very useful, with over half of interviewed respondents ranking it as "very useful."
- The tenant challenge approach is a harder sell for many businesses and requires an active coach to advocate and organize challenges.
  - After the first tenant challenge aimed at getting tenants to sign up for the program, a minority of buildings (14%) went on to participate in at least one of the online tenant challenges.
  - Among the 29 buildings that had participated in at least one tenant challenge, tenant engagement was limited: twelve buildings had three or fewer tenants create online user log-ins for SEiO's online tools – the Happen App or MyEnergyChallenge.com.[5]
  - Many coaches were relatively unengaged with tenant challenges and often not aware of the extent to which tenants were participating in the challenges. The largest barriers reported to participating in tenant challenges included difficulty engaging tenants and the amount of effort required.
  - The most engaged coach that was interviewed reported taking many actions not required by the program to promote the challenges and encourage participation, such as customizing emails to foster competition between the various teams within the organization.
- While overall satisfaction with program staff was high, over one-third of interviewed building operators and coaches mentioned issues related to implementation program staff turnover without being prompted. Building operators' comments suggest that staff turnover can create gaps in the customer experience in which customers are not in contact with program staff for a period of time, or may have to spend additional time and resources bringing new staff up to date on building and participation history.

[5] The Happen App and MyEnergyChallenge were developed by Accelerated Innovations. While Envision Charlotte was a catalyst for the development of the Happen App, and the app was used to help facilitate Envision Charlotte's non-energy challenges in 2016, Duke Energy, and not Envision Charlotte, helped fund the app.

1.4 Recommendations

Through the process and impact research, we identified several opportunities for program improvement.

Consider implementing more stringent requirements for what constitutes participation in SEiO.

The SEiO program has minimal requirements for what a customer must do to sign up for the program and be considered a participant. While this may help Duke Energy enroll a larger number of customers—and increase the chances of engaging them further—it also poses a risk for program savings. Overall, enrolled customers who have not reported implementing campaign actions have saved less energy. Including customers as participants when they are not actively participating (and presumably not saving energy) introduces noise that compromises the ability to measure energy savings amongst active participants. Moreover, because consumption increased on average for customers who had not implemented campaigns, including them as participants reduced overall program savings.

The program may be able to increase program savings by requiring more frequent engagement than simply completing one campaign in three years. Alternatively, if Duke Energy prefers to keep program requirements minimal to help get a foot in the door with difficult-to-engage customers, the program could differentiate between what is required of a participant to enroll in the program and what is required before Duke Energy claims savings for the customer. Currently these are defined by the same action: enrolling in the program, regardless of whether the customer has completed any campaigns. However, 63 of the 199 enrolled accounts included in our billing analysis had not reported completing any campaigns at the time of our evaluation. By creating a more stringent definition of "participation" and only claiming savings for those accounts that have interacted with the program beyond enrolling (for example, campaign participation or building benchmarking), Duke Energy could still enroll as many customers as possible and work to engage them in the program as part of the customer acquisition process, while minimizing the risk to realized program savings.[6]

In addition to requirements around campaign participation, Duke Energy should consider more stringent requirements around the contact information required at enrollment. We found that contact information for coaches and building operators was missing or outdated for a number of buildings, which limits the ability of program staff to engage these stakeholders (as well as our ability to collect data on the barriers to participation). Since building operators and coaches are key to driving savings through the program, not having these individuals identified is likely to reduce the program's effectiveness. Requiring current contact information from an operator or coach before they enroll would reduce the potential for buildings that are not saving energy, and it would ensure that program staff have the ability to engage all buildings.

Reconsider Targeting Strategy to Focus More on Customers with Higher Potential for Savings

The program currently uses a strategy for targeting potential participants that starts with more efficient buildings, such as ENERGY STAR Certified Buildings, under the theory that "these buildings represent property management and/or tenant organizations that place value on building energy performance, and would be likely to embrace a program that could provide new means to drive further energy efficiency

[6] Because the program is a unique mix of interventions for each participant, our evaluation depends on measuring changes in consumption after enrolling in the program. If consumption increases for a participant, which is more likely for non-engaged customers, this has the result of lowering average and total program savings.

improvements."[7] However, the results from this evaluation indicate that customers with less efficient buildings (higher EUIs and lower Energy Star scores) have a higher likelihood of saving energy. While customers with more efficient buildings may be easier to engage and more likely to participate because of their interest in saving energy, the results from our interviews suggest that these customers may already be implementing many or most best practices in building operations. Thus, there may be a trade-off between targeting more efficient buildings to achieve higher participation rates versus less efficient buildings that may achieve greater per-participant savings. It may be that program resources are more effectively used in targeting and engaging customers that have high EUIs and low Energy Star scores, even if these customers are harder to engage in the program.

Consider Increasing Focus on the Quality Rather than Quantity of Actions Promoted Through Campaigns

Building operator campaigns currently reward points for *answering* questions related to operator campaigns, regardless of whether or not there was any change in operator behavior or improvement in building energy efficiency. For example, a building operator receives the same number of points for answering yes or no to a question about whether they had made changes to equipment set-points. The information collected on the number of campaigns and number of building operator points does not help provide insight into the *quality* of actions that building operators are taking, and it does not show whether there are any behavioral changes taking place. This makes it hard for program staff to understand how effective these campaigns are in changing operations and maintenance practices. Having more nuanced data related to the quality of actions would help the program to understand how effective various campaigns have been and where there are opportunities to further target activities and customer engagement. In addition, shifting to performance-based awards instead of, or in addition to, activity-based awards may help better align building operators' motivations with program goals. To this end, the evaluation team understands that since the data was collected for this evaluation, Duke Energy has already started to develop a more customized approach to building operator campaigns in which participants will select and be rewarded for recording implementation of applicable building re-tuning measures.

Consider Additional Strategies to Encourage Building Operators to Meaningfully Engage in Campaigns and Other Interventions throughout the Year

Campaign tracking data revealed that over one-third of campaign actions were recorded in March 2016, shortly before the building operator awards dinner. Implementing many campaigns within a single month may dilute the impact of each campaign and result in less engagement throughout the rest of the year. Operators could be encouraged to engage consistently with bonus points for campaigns that are completed within the targeted window; both campaign participation data and operator interviews indicate that recognition is a powerful motivator for building operators. Alternately, campaigns could be open only during the targeted window and require staff approval to conduct a campaign at another time (for example, when a building enrolls in SEiO), setting a norm of implementing campaigns on the community-wide schedule.

Additionally, Duke Energy may want to consider more frequent timing for recognizing building operators and coaches. If awards were bestowed quarterly or bi-annually, that may help keep building operators and coaches engaged throughout the year, rather than just before the awards dinner. Moreover, Duke Energy could align the timing of awards with participation requirements or targets to help reinforce enhanced

[7] Smart Energy in Offices Plan Program Description and Theory Document.

requirements or targets. For example, some form of quarterly award or recognition could reinforce a target for each operator to complete at least one campaign per quarter.

Consider Additional Strategies to Engage Coaches, Captains, and Tenants to Increase Tenant Challenge Participation

Program participation and interviews with coaches revealed that, with a few notable exceptions, tenant challenge participation and coach engagement were low overall. Coaches that were most successful in engaging tenants actively promoted the program within their organizations, for example adding organization-specific content to the weekly SEiO email newsletters and encouraging competition between challenge teams. SEiO program staff should engage coaches and, to the extent possible, team captains on an ongoing basis to help them, in turn, to engage tenants. In particular, SEiO program staff should be in direct contact with a representative of each tenant/occupant organization, such as a captain in a multi-tenant building. Reaching captains may be particularly important in commercial real estate buildings, where building owners may enroll in the program, but not have a direct connection with the tenants of that building. In the case of commercial real estate buildings, it will be less likely that coaches are part of the tenants' organization, and thus coaches may have less ability to influence participation in tenant challenges. While participating organizations have generally resisted contacting tenant team members directly, they may be more amenable to contacting team captains, who have volunteered to engage in the program. The evaluation team understands that since the time data was collected for this evaluation, Duke Energy has decided to increase engagement with captains. At the time of writing this report, Duke Energy was planning an email campaign to enroll more captains as well as focus groups with captains to better understand their motivations.

Consider Making Low-Cost, Low-Touch Components of the Program More Broadly Available to Participating Organizations

One coach reported that not all of the organization's buildings were eligible for SEiO, and consequently could not take advantage of automated building benchmarking for these buildings. In the end, the organization decided to continue to manually benchmark the entire portfolio, rather than benchmarking some automatically and some manually. If it is low cost to the program, allowing all buildings within a portfolio to connect to automated benchmarking would reduce the barriers and confusion related to automating a portion of the buildings. Similarly, implementation staff reported that one organization exited the program because not all buildings were eligible for the program, but the organization's policy did not allow for a subset of buildings to participate, specifically in the building operator campaigns. In this case, allowing these other buildings to access the Smart Energy HQ and campaigns may have allowed the *eligible* buildings to participate. If software services, benchmarking, operator campaigns, and tenant challenges could be expanded to participating organizations' ineligible buildings with minimal additional cost, this may lead to spillover in those buildings.

Provide a Visual Dashboard of Participation in Tenant Challenges

Coaches reported that SEiO provided little feedback on tenant challenge participation other than the campaign leaderboard, but that this type of feedback was available for the previous version of the tenant campaigns that used the Smart Energy HQ. In addition to giving direct feedback to tenants that might motivate individual participation in the challenges, such a dashboard could provide content used to customize messaging to an organization's teams, as requested by one coach. The dashboard could provide data on participation in the challenges at different levels—such as organization, team, and individual—that would allow users to find the relevant data for their organization or team.

Conduct Future Research into the Influence SEiO Has on Participation in Other Energy Efficiency Programs Offered by Duke Energy

One question that this evaluation did not answer is what influence the SEiO program is having on participants' decisions to complete capital improvements through Duke Energy's other energy efficiency programs. This is an important question, as we found that all six SEiO customer groups had saved energy before deducting savings from other programs, but not after this adjustment had been made. If some or all of the savings from other energy efficiency programs are attributable to SEiO, this could have a significant effect on the program's cost-effectiveness.

This question can be addressed through future evaluations by asking participants about the role and influence of SEiO on their decision to implement capital improvements through Duke Energy's energy efficiency programs. However, Duke Energy may also want to collect data to track this internally, to help mitigate recall bias as well as the challenges of contacting decision makers after the fact. For example, Duke Energy could add codes such as "Through SEiO Program" or "Through participation in another Duke Energy Program" to the program tracking data collected on how customers hear about the Non-Residential Prescriptive and Custom programs. Collecting this for all participants in program tracking databases would provide a quicker and fuller picture of SEiO's influence than could be collected through a sample of building operators and coaches during the next evaluation.

2. Program Description

2.1 Program Design

Smart Energy in Offices (SEiO) is a Duke Energy Carolinas (DEC) behavioral demand-side management program targeting electricity conservation in mid- to large-sized office buildings.[8] The program takes a holistic approach to energy consumption within office buildings by offering multiple interventions, including (1) engaging building operators with trainings and campaigns related to energy efficient building operations and maintenance; (2) engaging tenants through community-wide challenges related to energy efficiency within office spaces; and (3) providing participants with detailed data on their energy consumption and automated building energy benchmarking. Participating operators and tenants earn points for their engagement, providing positive feedback, social norms, and/or competition between individuals, teams, buildings, and communities, all of which may contribute to motivating energy-saving actions and behaviors. The program is designed to complement Duke Energy's existing equipment-based rebate programs by focusing on behavioral and operational savings. Additional information about program design is detailed below, organized by building operator and tenant engagement.

The SEiO program has been offered since September 2014. The program is available to customers with buildings that are at least 10,000 square feet and 50% office space by floor area. To support the community engagement aspect of the program design, there must be at least three buildings in a geographic community to be eligible. There are no direct costs or financial incentives for participants.

SEiO was adapted from the predecessor pilot program, Smart Energy Now (SEN), which Duke Energy implemented in Uptown Charlotte, North Carolina, between October 2011 and August 2014. Duke Energy made a number of changes when creating the SEiO program based on their experience with the SEN pilot. For example, a primary component of the SEN pilot were kiosks installed in participating buildings showing real-time community-wide energy consumption. Because these kiosks were expensive and not found to influence energy-saving behaviors, they were dropped from the SEiO program. Overall, the SEiO program has focused more on building operations—such as optimizing maintenance, scheduling, and set-points—than the SEN pilot, which focused more heavily on tenant savings. The SEiO program includes more tools, trainings, and campaigns focused on building operators, as program staff expect to achieve larger savings through building operator engagement than tenant engagement.

The SEN pilot was launched in conjunction with the public-private collaborative Envision Charlotte sustainability program. Specifically, SEN was managed by Duke Energy and served as the energy-specific component of the broader Envision Charlotte program, which also focused on water, air quality, and waste. Envision Charlotte and SEN were cross-promoted during the pilot period, and this collaboration has continued with SEiO. Duke Energy has worked with Envision Charlotte to ensure that SEiO continues to deliver all energy-focused interventions, while Envision Charlotte focuses on the remaining pillars of water, air quality, and waste. For customers in Uptown Charlotte, SEiO and Envision Charlotte have been cross-promoted and, for a limited time, shared tools including an online app, called the Happen App, which participants use to track program activities.[9] The evaluation period addressed in this report is September

[8] Buildings must be at least 10,000 square feet to participate, although the program does target larger buildings that are at least 100,000 square feet. While buildings as large as two million square feet or more are participating, the average size of buildings is around 160,000 square feet.

[9] Envision Charlotte used the Happen App to promote a couple events in 2016, but no longer utilizes the Happen App.

2014 through February 2017. Because at least twelve months of post-participation data are required to estimate program savings, this evaluation included customers who had enrolled by the end of February 2016.

2.1.1 Operator Engagement

SEiO targets energy savings from improved building maintenance and operations (M&O) through a number of interventions. One of the primary components of the program are "building operator campaigns," which provide information, encourage best practices, and reward or recognize operators for being energy efficient. These three- to eight-week campaigns are promoted on a program-wide schedule through the program's online tool, the Smart Energy HQ, where building operators can learn about campaigns, download promotional materials about the campaign, and log the campaign actions they take. Building operators earn points for logging campaign activities in the Smart Energy HQ,[10] and high-scoring operators are recognized at the program's annual awards dinner. The theory behind the campaigns is that the rewards and recognition are powerful tools for motivating building operators to enact efficient M&O practices. In addition, by helping building operators communicate the value of efficient M&O practices, the program's campaign collateral and recognition help building operators garner support from building management and tenants. Table 2-1 summarizes the building operator campaigns implemented by the program at the time of the evaluation.

Table 2-1. Summary of Building Operator Campaigns

Campaign	Description/Desired Outcome
All about that BAS	Verify accuracy and calibration of your building's Building Automation System and associated sensors.
Clean Sweep	Work with cleaning crews to report equipment running after hours, turn off lighting, and adjust cleaning schedules to reduce energy waste
Coasting Time	Shorten building system operating time at the end of the workday.
Damper Derby	Verify proper operation of dampers, linkages, and actuators, and adjust them if necessary.
Go with the Flow	Optimize HVAC system operation, including air flow, pressure, operating schedules, and fan or motor efficiency.
Performance Pit Stop	Perform regular building HVAC maintenance.
Set-point Summit	Update occupancy schedules and set-points for when the building is not in use.
Shake up your Wake-up	Shorten building system operating time at the beginning of the workday.
Watts with the Weather	Increase thermostat set-point during the summer months.
How Low Can You Go	Identify opportunities to reduce after-hours energy consumption.
Let It Go	Review lighting schedules to make sure they align with occupancy schedules and identify other opportunities to reduce lighting waste.
Where You at Thermostat?	Verify the calibration of room sensors and thermostats, and calibrate or replace thermostats if necessary.
Wiser Economizer	Review economizer temperature plots and identify discrepancies, and verify economizer sensor calibration.

[10] Each campaign includes a series of questions in the Smart Energy HQ related to building characteristics, operations, and maintenance. Building operators are awarded points for answering the questions, regardless of whether they implement the efficient practices being promoted through the campaign.

In addition to the campaigns, additional services are available to building operators, including (1) data on their buildings' energy use through the Smart Energy HQ; (2) automated building benchmarking results through ENERGY STAR Portfolio Manager; and (3) walk-through energy audits conducted by University of North Carolina Charlotte (UNCC) students. Access to energy use data and building benchmarking results are intended to contribute to behavioral energy savings by providing operators with feedback regarding their buildings' energy consumption. When the program began, only monthly data was available through Portfolio Manager and the Smart Energy HQ. Around January 2017, however, the HQ was updated to include hourly data from web-connected meters to give building operators more precise energy use information. At the time of writing this report, about half of participating buildings had access to hourly data and program staff were continuing to work with Duke Energy to access hourly meter data for the remaining participants. The UNCC audits were added to the program in the fall of 2016 to provide another source of value for building operators. After conducting a walk-through audit and reviewing building operations data, the UNCC students provide each participating building with an energy report outlining M&O savings opportunities and assist them in implementing building operator campaigns.

The program also seeks to connect building operators through (1) semi-annual building operator forums, where building operators can meet in person and share best practices; and (2) an Operator Exchange Network, where operators can be paired up with another operator to share information on efficient practices. In addition, there is an annual awards dinner for building operators, where high-scoring participants are recognized for their achievements. The program also added a tool lending library in Spring 2016, where participating building operators can borrow metering and data logging equipment to help identify energy savings opportunities. Building operators are asked to meet with the next operator who checks out equipment after them, to help reinforce the Operator Exchange Network.

2.1.2 Tenant Engagement

SEiO also encourages energy conservation for building occupants and tenants (collectively "tenants"). The methods the program uses to engage tenants have evolved since the program's launch in 2014. When the program started, the program offered participating buildings access to tenant "campaigns" that they could implement on their own schedule. These campaigns were similar to tenant interventions offered through the SEN pilot program and used office competitions, often relying on physical props, to generate savings. Based on difficulties that the program experienced gaining adoption and scaling this model to the full SEiO program, the program switched to community-wide tenant "challenges" in the summer of 2016. Through these challenges, tenants are provided with actions they can take to save energy and are asked to log their commitment to taking these actions. Tenants log their actions through their choice of two tools the program has developed, a smartphone app called the Happen App or the website MyEnergyChallenge.com. Tenant challenges are now offered to all participants seasonally on a community-wide calendar.

Tenant engagement involves three levels of participants. At the highest level, the program designates a **"coach"** at each participating organization who serves as the primary stakeholder for tenant engagement and is responsible for promoting challenges to the building's tenants. Coaches help recruit team **"captains"** who organize and encourage teams of tenants, the individuals working within the office building, to participate. Teams can be made up in many ways, such as individual organizations within a commercial real estate building or different floors or departments within an owner-occupied building. Communications from SEiO are directed to coaches, who either distribute them to captains or directly to tenants. In the former, captains then distribute communications to tenants.

Tenant Challenges

SEiO tenant challenges are community-wide competitions where tenants commit to taking various energy-saving actions encouraged by the program. Challenges last approximately six to eight weeks and can be accessed either through the Happen App or MyEnergyChallenge.com, which display the same information to users. Each day, tenants can commit to taking the actions encouraged by the challenge to earn points. Each week, one action from the challenge is highlighted as the focus for the week, which is communicated to tenants through email messages created by SEiO program staff. A key role of coaches and captains is to distribute these emails to tenants, in order to drive awareness and engagement in the program. At the time the data was collected for this evaluation, the program had completed three tenant challenges, which are described in Table 2-2; another challenge, called "Spring in Your Step," was planned for April and May 2017, after data collection was complete.

Table 2-2. Summary of Program Tracking Data for Program Period

Challenge	Date	Encouraged occupants to…
Butterfly Effect	Summer 2016	Dress in layers, unplug chargers when not in use, and turn off lights and monitors when not in use. Earn a different colored butterfly for taking each action.
Fall Off	Fall 2016	Adopt spaces, plug loads, lights, devices, monitors, and power strips and make sure they are off and/or unplugged when not in use.
Winter Warm Up	Winter 2017	Dress in layers, make the most of natural daylight, and promote the program to friends and colleagues.

Tenant challenges can be characterized as a behavioral intervention in four dimensions:

- **Reminders:** Simply reminding tenants to take specific energy-saving actions, such as through the weekly emails from SEiO team captains, may increase tenants' likelihood of doing so.
- **Commitment:** Tenants are asked to commit to taking specific actions each day, such as monitoring a light switch to make sure it stays off when not in use. Committing to such actions ahead of time can increase the frequency they occur throughout the day.
- **Reciprocity:** Users earn a point for each action they commit to throughout the day. After having been rewarded with a point, tenants may feel more responsible for following through on these actions in return.
- **Recognition/Competition:** Tenants' points are displayed on public leaderboards within the Happen App and MyEnergyChallenge.com that are visible to all other users. Users may be motivated to compete to get the most points and/or to simply earn a "normal" or "average" amount of points.

Tenant Campaigns

As mentioned above, the program initially implemented tenant "campaigns" that were more focused on competitions within offices. These campaigns were implemented on the individual building's schedule[11] and often involved physical props (such as plastic crabs or vampire teeth). Each time a coach wanted to

[11] While coaches chose when to offer most campaigns, the program also offered bi-annual community-wide campaigns at specific times of the year.

implement a campaign, there were a number of steps required of the program and participants, including recruiting captains, holding captains' meetings, choosing a schedule for the campaign, providing instructions, and sending customized registration codes that teams needed to join a challenge. All of these factors made the campaigns difficult to scale. Table 2-3 summarizes the tenant campaigns offered earlier in the program.

Table 2-3. Overview of Tenant Campaigns

Campaign	Encouraged occupants to…
Add it Up	Register in the Smart Energy HQ and complete personal workplace energy use profile to gain insight on the end uses that they can control and help characterize their buildings' opportunities for energy savings.
Adopt A Light	Avoid energy waste by adopting common area light switches and reminding coworkers with wall-friendly decals to turn lights off when not in use.
Butterfly Effect	Commit to making the simple energy-saving changes recommended during the challenge period by visiting myenergychallenge.com to register and begin recording actions daily. Each recorded action is paired with a different butterfly that will identify participation on the leaderboard.
Make Cool Choices	Record sustainable actions each day to earn points and push their team to the top of the leaderboard of the online Cool Choices game.
Crab, You're It!	Have fun pointing out co-workers' energy waste by placing plastic crabs where office lights or computer monitors were left on prior to discovery.
Energy Vampire Stakeout	Unplug devices that contribute to "vampire loads" by leaving plastic vampire teeth by equipment that has been left plugged in when not in use.
Resolve to Revolve	Be greeted and recognized for saving energy by using revolving doors instead of swing doors.
Caught Green Handed*	Earn a token each time a tenant is observed practicing energy efficient behaviors at his or her desk. Each token represents an entry into the drawing to win additional vacation days. *Available to Mecklenburg County participants only.

While the tenant challenges described previously were loosely modeled on these original tenant campaigns, they had several notable differences. Tenant campaigns often used physical props such as the plastic crabs used in *Crab, You're It!*, whereas challenges leverage more web-based content to make participation easier and more scalable. Campaigns could be selected and scheduled by an individual building, company, or team, rather than being implemented community-wide on a set schedule. The underlying theory of campaigns' behavioral interventions were also slightly different. Instead of commitment and reciprocity, the program used simple rewards. While both approaches also encouraged competition, tenant campaign competition was largely limited to within the organization because campaigns were implemented on a customer-driven schedule. Additionally, under the campaign model, tenants earned points for *taking* individual actions (e.g., turning off a light), rather than for *committing* to take actions (e.g., adopting a light) over the course of the day. Another difference between campaigns and challenges is the role of captains. The theory behind the campaigns was that team-based competitions led by office captains would foster peer-driven, bottom-up excitement, rather than pushing a top-down model. In the new challenge model, captains play a smaller role in organizing and implementing activities.

This evaluation focuses on the tenant challenges, rather than campaigns, since the program will only be running challenges in the future for the reasons outlined above.

2.2 Program Implementation

Duke Energy implements the SEiO program with the assistance of an implementation team led by Accelerated Innovations (AI). While a Duke Energy program manager oversees the program, Accelerated Innovations is responsible for managing the program activities for building operators and tenants, including customer outreach and engagement, operator campaigns (including the Smart Energy HQ platform), tenant challenges (including the Happen App or MyEnergyChallenge.com platform), and building operator events. The Accelerated Innovations program team includes the project manager, a content development team, a web platform development team, and outreach staff. ICF International serves as a subcontractor providing the in-field engagement manager staffing. ILLUME Advising serves as a subcontractor to Accelerated Innovations to provide feedback on the program design and implementation, including collecting feedback from participants in order to improve the program. Cool Choices, another sub-contractor, also advised on the behavioral science design of the program and facilitated the Cool Choices game as part of the tenant campaign offerings.

The program is marketed to medium and large office building customers through targeted outreach and communications by the program staff. While all eligible customers can enroll in the program, the program team has prioritized specific types of buildings when conducting outreach. Specifically, the program developed a "targeting list" of customers who would be the best candidates to save energy through the program, based on the following criteria:

- Participants in the SEN pilot
- Large commercial buildings (>100,000 square feet)
- Buildings identified by Duke Energy account managers as good targets
- ENERGY STAR Buildings
- Buildings that are owner-occupied, master-metered, or have full service leases
- Top regional commercial property management firms, identified using proprietary rankings

Buildings that do not meet the above criteria, such as smaller buildings or buildings with triple net leases, are welcome in the program but are not as actively pursued. Smaller buildings that have been recruited are generally part of a larger portfolio of buildings that includes other high-priority buildings.

After identifying target buildings based on the criteria above, staff from the Accelerated Innovations team reach out to property management firms, building owners, and anchor tenants to generate interest in the program. Outreach staff use a mix of strategies to recruit customers, including in-person meetings, written program collateral, and presentations at industry meetings, among others. Once a customer expresses interest, the program asks that an individual with signing authority for the property manager/building owner/anchor tenant sign a program agreement form to formalize their participation. After this, the program sends the customer a welcome email within five days; the date of this email is considered the customer's participation start date. Outreach staff then hold an orientation meeting with the customer within a few weeks to introduce building stakeholders to the program and the Smart Energy HQ.

The recruitment and engagement activity described above occurs at multiple levels, depending on a building's ownership structure. The program uses the term "coordinating organization" to describe the organization with which SEiO initiates the program. This is often a property management firm or parent company that owns or leases multiple buildings. Stakeholders at the coordinating organization then identify

the relevant key stakeholders that will serve in the coach and building operator roles for each building. Program outreach staff continue to work with coaches and building operators throughout their tenure in the program to encourage them to participate and to help guide them through the program's various offerings. While the program design envisions having a coach and building operator at each building (even if they are the same individual), in practice not all buildings had an assigned coach and/or building operator.

Buildings enroll to participate in the program for a three-year period. Each building is required to complete at least one campaign during this three-year period to be considered a participant, although the program encourages customers to implement all of the campaigns in each campaign cycle in order to receive the highest levels of recognition and ensure building systems are optimized to avoid energy waste.

Since the program first launched in September 2014, Duke Energy has continued to use feedback on the program's implementation to continuously improve the program design. For example, the switch from tenant campaigns to challenges was based on feedback received related to the barriers to implementing tenant campaigns. In 2016, the implementation team conducted its own internal research with building operators, tenants, and coaches to help identify barriers to more fully engage with the program, motivators that drive participants to engage, and actions that customers are currently taking through the program. Duke Energy is using this research to make a number of changes to the program design in 2017 that are not reflected in this evaluation, since the evaluation focused on program implementation between 2014 and 2016.[12] Where relevant to our findings, we discuss these changes throughout this report.

2.3 Program Participation and Performance

Based on the program-tracking database, 199 accounts (spanning 178 buildings) were enrolled in the program during the evaluation period (accounts enrolled on a rolling basis between September 17, 2014 to February 29, 2016). For each account enrolled, Duke Energy claimed ex ante savings as a percentage of baseline annual consumption, using percent savings values from the SEN pilot evaluation.[13] Using this approach, the participants included in this evaluation account for almost 43,000 MWh of ex ante gross annual savings. While large accounts (>100,000 square feet) make up less than half of all enrolled accounts, they comprise 85% of annual baseline consumption and 97% of the ex ante savings. The number and ex ante savings for enrolled accounts are summarized in Table 2-4.

Table 2-4. SEiO Evaluation Population and Ex Ante Gross Savings by Building Size Category

	Accounts		Baseline Consumption		Ex Ante Savings	
Building Size	Number	Percent	MWh	Percent	MWh	Percent
Large (>=100,000 square feet)	93	47%	533,628.8	85%	41,648.7	97%
Small (<100,000 square feet)	106	53%	96,198.1	15%	1,290.4	3%
Total	**199**	**100%**	**629,826.9**	**100%**	**42,939.1**	**100%**

[12] While savings are based on data through February 2017, our primary data collection with participants occurred in 2016 and January 2017. As such, our feedback on program performance is focused on their experience through mid- to late-2016.

[13] The initial SEN pilot evaluation found that large customers saved 7.8% energy savings while small customers saved 1.3%. TecMarket Works, "Impact Evaluation of the Smart Energy Now Program (NC) (Pilot)." February 21, 2014.

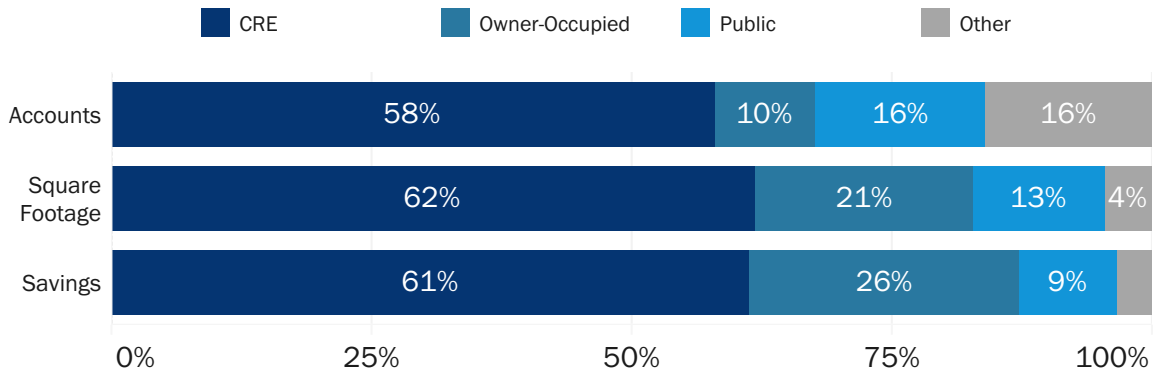
Table 2-5 shows the relative number of accounts and ex ante savings from Smart Energy Now (SEN, the precursor pilot program) participants and non-participants. SEN participants were also exposed to Envision Charlotte, the community-wide sustainability program in Charlotte that is cross-promoted with SEiO and SEN.

Table 2-5. SEiO Evaluation Population by Smart Energy Now Pilot Participation

Smart Energy Now (SEN) Pilot	Accounts		Baseline Consumption		Ex Ante Savings	
	Number	Percent	MWh	Percent	MWh	Percent
SEN Participant	33	16%	350,361.5	48%	23,003.5	64%
Non-SEN Participant	166	84%	375,835.6	52%	19,935.5	46%
Total	199	100%	726,197.1	100%	42,939.1	100%

Figure 2-1 shows the percentage of accounts, square footage, and ex ante savings by sector. While commercial real estate (CRE) buildings make up the majority of accounts, square footage, and savings, owner-occupied buildings comprise an outsized share of square footage and ex ante savings due to their larger average size.

Figure 2-1. Distribution of Enrolled Accounts, Square Footage, and Ex Ante Savings by Sector



3. Overview of Evaluation Activities

To address the research objectives outlined in the previous section, the evaluation team performed a range of data collection and analytic activities, including:

- Program staff interviews
- Program materials review
- Building operator and coach interviews (n=20)
- Building operator and coach follow-up NTG survey (n=9)
- Tenant survey (n=6)[14]
- Database analysis
- Deemed savings review

3.1 Program Staff Interviews

The evaluation team completed both formal and informal interviews with program staff at Duke Energy and Accelerated Innovations. Formal interviews with Duke Energy program managers were conducted in January 2015 and January 2016. These interviews explored program design and implementation, program performance, and data tracking and communication processes, among other topics. The evaluation team also met with Duke Energy and Accelerated Innovations to review program tracking data tools, program changes, and research priorities nine times throughout the remainder of 2016 and early 2017.

3.2 Program Materials Review

The evaluation team reviewed various program documentation and materials, as well as the Smart Energy Now (SEN) pilot evaluation report. Program documentation included summary documentation describing the program design and implementation approach, as well as marketing materials and collateral developed for building operator campaigns, tenant campaigns, and tenant challenges. These materials included campaign and challenge calendars, campaign landing page descriptions, operator campaign awareness signage, and tenant challenge weekly emails. The evaluation team also logged into the Smart Energy HQ, Happen App, and MyEnergyChallenge.com to understand the program's online user experience.

3.3 Building Operator and Coach Interviews

In support of the impact and process evaluations, the evaluation team conducted in-depth interviews with SEiO building operators and coaches. While the roles of building operator and coach are distinct within SEiO, the evaluation team conducted a single set of interviews to accommodate accounts for which a single individual filled both roles. However, interviews were tailored to the role(s) played by each interviewee. The

[14] Due to challenges distributing the tenant survey, the survey was closed before a sufficient number of responses was collected, so the survey was not analyzed in its entirety. When possible, findings are presented within the tenant engagement section of the process evaluation.

interview served to support process evaluation research questions, as well as to gather data on building operations from building operators in support of the impact evaluation. Key research questions included the following:

Gross impact evaluation

- What changes have occurred to building occupancy and usage that should be accounted for when estimating gross energy savings?
- For capital projects completed through other Duke Energy energy efficiency programs, what are the project characteristics (timing, savings, etc.) needed to isolate SEiO savings through a billing analysis?

Process evaluation

- How do participants become aware of the program?
- Why do participants decide to enroll in the program and participate in campaigns?
- What keeps some building owners and managers from participating fully in the program?
- Why do participants decide not to participate in various campaigns?
- How satisfied are stakeholders with the program? With each intervention?
- How much do participants value the various program elements targeted at building owners and operators, such as the building operator campaigns, automated building benchmarking, operator forums, and awards/recognition? What modifications could improve the experience and increase engagement?
- How much do participants value the various program elements targeted at tenants, such as information about building energy usage or competitions? What modifications could improve the experience and increase engagement among tenants?
- How much do participants value the communication and feedback channels available through the program, such as the Smart Energy HQ, Happen app, email outreach, and direct communication with program staff? Do participants have any recommendations for improving communication?
- To what extent has the SEiO program motivated participants to pursue additional energy efficiency savings beyond the operations, maintenance, and behavioral practices promoted by the program?

Sampling Approach

Overall, we interviewed 20 building operators and/or coaches who represented 50 different participating accounts. When developing a sampling strategy for these interviews, we stratified our sample into six strata along three different dimensions: size of the building, whether the customer had been engaged with the program, and whether the customer had participated in the SEN pilot or not. These stratification variables were chosen to capture the range of interactions participants have had with the program, as well characteristics most likely to affect program savings, as summarized below and described in more detail in Appendix A: Sampling Strategy:

- **Building Size:** Building size is important because Duke Energy's ex ante savings are tied to building size, with large customers' ex ante savings being a higher percentage of pre-program consumption than smaller customers' percentage of their own consumption. Using the same definition that Duke Energy used for ex ante savings, participants that are identified as "large" have a confirmed building square footage of over 100,000 square feet.

- **Participant Engagement:** As customers choose their own level of participation in the program, engagement will be a key factor driving energy savings. For sampling purposes, participants were classified as "engaged" if they had recorded participating in at least one campaign in the Smart Energy HQ. Participants were classified as "non-reporting" if they have not recorded any campaign actions in the Smart Energy HQ. These customers may not have implemented any of the actions targeted through campaigns, or they may implement campaign activities without taking the step to record actions in the Smart Energy HQ. Because some customers participated in their first campaign after our sampling strategy was developed, we have since re-classified those customers from when our sample was originally developed.

- **SEN Pilot Participant:** SEN pilot participants are different than non-SEN participants for two reasons. First, these participants started engaging with Duke Energy earlier, during the SEN pilot, and have continued this engagement through SEiO. Second, for the most part, these customers are also Envision Charlotte participants. There are synergies between SEiO and Envision Charlotte, with staff from both efforts cross-promoting each other's programs. Envision Charlotte and SEiO also for a period shared an engagement app, the Happen App, intended to make it streamlined for customers to engage with both offerings.[15] Because of these differences, it may not be possible to extrapolate the experience of Envision Charlotte participants to the larger population of SEiO participants.[16]

Because large and engaged customers are more likely to drive program savings, we oversampled these customers, as summarized in Table 3-1. While our sample was designed at the account level, many building operators and coaches are associated with multiple accounts. Amongst building operators, for example, one individual is listed as the operator and coach for 42 accounts from a single coordinating organization, while 19 operators and 19 coaches are associated with only one account. When we identified a building operator that worked on more than one participating account, we asked this individual questions to support the gross impact evaluation (about changes in building operations and usage) for up to **five accounts**, selected randomly. We chose to limit each individual building operator to five accounts to minimize respondent burden and ensure we collected accurate data for sampled accounts.

[15] Envision Charlotte has stopped using the Happen App to promote its activities.

[16] Duke Energy did not have a complete list of Envision Charlotte participants, so SEN participation was the best available proxy for Envision Charlotte participation.

Table 3-1. Building Operator and Coach Interview Sampling Approach

Stratum	SEN Pilot	Size Category	Engagement Level	Population No. of Accounts	Population % of Accounts	Sample No. of Accounts	Target Sample % of Accounts
1	Non-Participant	Large	Engaged	51	26%	18	36%
2			Non-reporting	16	8%	2	4%
3		Small	Engaged	65	33%	22	44%
4			Non-reporting	34	17%	1	2%
5	Participant	All	Engaged	20	10%	6	12%
6			Non-reporting	13	7%	1	2%
Total				199	100%	50	100%

The 20 individuals we interviewed represented a mix of 10 building operators, 5 coaches, and 5 individuals who played both the building operator and coach roles. These individuals comprised over one-quarter of the building operators and coaches listed in the implementation team's database, as shown in Table 3-2. We collected feedback from building operators representing the target of 50 accounts, while feedback from coaches represented 37 accounts.

Table 3-2. Building Operator and Coach Interview Sampling Approach

Role	Individuals in Population	Individuals in Sample
Building Operator only	34	10
Coach only	32	5
Building Operator and Coach	12	5
Total	78	20

3.4 Building Operator and Coach Follow-up Survey

After completing an in-depth interview, the evaluation team invited building operators to complete a follow-up online survey regarding each of the operator campaigns they had been involved with. The purpose of this survey was to collect data on the actions building operators would have taken to save energy in the absence of the program in order to estimate the program's free-ridership (i.e., the portion of gross savings that would have occurred in the absence of the program). Respondents were offered a $100 incentive to take the follow-up survey. Research questions included the following:

Net impact evaluation

- How much influence is the SEiO program having on energy efficiency decisions and practices within participating organizations?
- To what extent were participants already implementing the types of operations, maintenance, and behavioral practices promoted by the program?

Of the 15 building operators we interviewed, 9 completed the follow-up online survey, representing 38 of the 50 accounts covered through the interviews. None of the five respondents who were coaches only (and not building operators) completed the follow-up survey.

3.5 Tenant Survey

The evaluation team fielded an online survey of SEiO tenants in March 2017. Research questions included the following:

- How satisfied are tenants with the program? How does satisfaction vary by intervention (i.e. challenge)?
- Why do tenants decide to participate in various challenges?
- How much do captains and tenants value the various program elements targeted at tenants, such as information about their energy usage or competitions? What modifications could improve the experience and increase engagement among tenants?
- How much do captains and tenants value the communication and feedback channels available through the program, such as MyEnergyChallenge.com, the Happen app, and communication with program staff? Do captains or tenants have recommendations for improving communications?

To help motivate tenants to respond to the survey, respondents were entered into a drawing for one of six $50 gift cards.

The SEiO program does not have contact information for all tenants at participating buildings, as this is sensitive information that building owners and property managers often do not want to share. While the program does have contact information for tenants that create Happen App or MyEnergyChallenge.com accounts, Duke Energy did not want the evaluation team to contact tenants directly given building owners' sensitivity around contacting these customers. Instead, the evaluation team relied on on-going program communications with tenants to field the survey. First, the program team included a link to the online survey in a weekly email for the Winter 2017 "Winter Warm Up" challenge. Because the program does not contact tenants directly, this email was sent to coaches, who are asked to distribute either to team captains or directly to tenants.

The number of completed surveys from this distribution approach was too low (4 responses) to analyze. To encourage additional tenants to take the survey, the program team embedded a link to the survey on the MyEnergyChallenge.com landing page during the Spring 2017 "Spring Into Your Step" campaign. However, this link was not visible to customers who have their account log-in information saved (and thus skip the landing page) or those who use the Happen App.[17] In total, six tenants provided valid survey responses. These results are not presented in detail in this evaluation due to the low total number of surveys completed.

[17] The program team was technically unable to embed the link at locations that may have offered greater visibility. While the program team may have found a way to do this, the Duke Energy legal team asked that the survey be removed until a legal review was complete. By the time this was done, the Spring 2017 challenge was over and it was too late to include the survey in this evaluation.

3.6 Database Analysis

The evaluation team received program-tracking data through a web portal developed by Accelerated Innovations. Data provided through this portal included:

- **Account-level:** customer & building information, sector, annual consumption, ex ante savings, and other background information.
- **Operator campaigns:** campaign start dates and number of actions taken for each building.
- **Tenant challenges:** dates of individual actions pledged by participants for each challenge.
- **Key stakeholder:** contact information for the primary coach and building operator for each account (and secondary coach or operator, if available).
- **Operator awards:** total number of points and operator award level for each building.
- **Occupancy:** self-reported percent occupancy by building and month (when provided by building operators).
- **Benchmarking:** earliest and most recent ENERGY STAR scores for buildings that are benchmarked and eligible for the score.

The evaluation team reviewed these datasets in order to stratify the population of participating accounts, develop a sampling strategy, and analyze operator campaign and tenant challenge participation trends over time and by building sector.

In addition, the evaluation team conducted a review of program documentation, plan filings, and prior program evaluations to understand Duke Energy's estimated ex ante per unit savings for the program. The results of this deemed savings review are included in Appendix C.

4. Gross Impact Evaluation

Our gross impact evaluation was designed to estimate gross energy and peak demand savings. To do so, we developed site-specific billing analyses for each participant that compared pre- and post-enrollment whole building energy consumption data, controlling for weather and changes in each building's occupancy.

4.1 Methodology

In this section, we first define what we mean by "program participant," then describe the methods used to calculate energy and demand savings.

4.1.1 Participation definition

The first step of this evaluation was to define who a participant is and what period of the program was being evaluated. These definitions were more challenging than with traditional equipment programs, or even other behavioral programs for a number of reasons. First, customers choose their own level of engagement, meaning that what it means to "participate" in the program varies considerably from customer to customer. For example, some customers complete tenant challenges, some complete building operator campaigns, some do both, and some do neither. Second, the effects of the program are expected to be cumulative over the three-year participation period that participants commit to when they enroll. Recently enrolled participants may have engaged in few or none of the program campaigns while those who have been enrolled longer may have completed more campaigns. Third, the program has changed what offerings are available to enrollees since its launch in fall 2014. For example, tenant campaigns are now run as community-wide challenges and offered in defined months, rather than implemented on a building team's own schedule. Thus, there have been different potential activities and program support available during the tenure of enrollment for early enrollees versus later enrollees. These considerations are not unique to the launch of the program; as long as the program is continuously enrolling participants for three-year contract periods during which participants choose their engagement path, any evaluation will have to develop cut-offs for who to include and what time frame is being evaluated.

For this evaluation, we have defined participants as buildings that have enrolled in the program, even if they did not record completing any campaigns or program activities during our evaluation period. This is the only definition that can consistently be applied to all accounts, and also ensures that we capture savings from non-observable impacts from the program, like having access to building energy use data through the Smart Energy HQ portal. This evaluation included buildings that enrolled in the program between September 2014 and February 2016. By including accounts that enrolled during this time period, we are able to include at least 12 months of post-enrollment billing data in our analysis for all participants. For these participants, we will be estimating savings from their enrollment date through February 2017. Because many of the participants may go on to engage in more program campaigns after our February 2017 cut-off, the gross evaluation results provide a very specific measure of the program's impacts: savings through February 2017 from accounts that enrolled between program inception and February 2016. To the extent that program offerings have changed or participants have engaged more deeply since February 2017, our gross savings estimates may not reflect the savings participants realize over their entire three-year enrollment period. For more discussion of how this evaluation is capturing a snapshot of savings over a particular time period, see Appendix A: Gross Impact Methodology.

4.1.2 Gross Energy Savings Billing Analysis Model

To estimate gross energy savings, we developed site-specific time series analyses of monthly billing data at the building level for each participant.[18] Although it is often desirable to develop a control group for behavioral program evaluations, a control group was not feasible for this evaluation due to the program design. Each program participant was enrolled as part of a defined community and it was not feasible to reject or delay the participation of a portion of the community to create a control group, nor was it feasible to identify representative control group communities to match to the participant communities. In addition, the program specifically targeted customers most likely to save through the program, as discussed in Section 2.2; because of this, similar non-participant businesses are likely to have been approached by the program and decided not to participate. Using these customers would introduce a bias, as the control group would likely consist of customers who chose not to participate, potentially because of underlying differences that make them dissimilar to participants.

To model energy savings, we compiled data from multiple sources. The main data source was monthly billing data, provided by Duke Energy, comprising consumption data for accounts associated with participating customers.[19] The evaluation team paired this billing data with local hourly weather data provided by the National Oceanic and Atmospheric Administration (NOAA). Participation data and self-reported data on building characteristics (such as occupancy) was obtained from Smart Energy HQ, and matched to the billing/weather data. Finally, the evaluation team conducted interviews with building operators in order to capture information that might be useful in the billing analysis but would not otherwise be captured, as described in Section 3.3.

Although billing information was provided at the account level, the evaluation team determined that it was more appropriate to conduct the analysis at the *building* level for two reasons:

1. Given that SEiO participation activities were conducted at the building level, all accounts in the same building had identical campaign participation records.

2. Multiple accounts in the same building are likely not independent in their response to ambient weather conditions, as the heating/cooling response by one account will be closely linked to (and may even affect) the heating/cooling response of another account that is physically connected (i.e., at the same premise).

Thus, all subsequent analyses used the building as the unit of analysis. To corroborate the robustness of this approach, we also ran all models at the account level and found very similar results.

Before selecting a billing analysis model, we tested multiple specifications to understand the trade-off between estimating savings only using participants for whom we had detailed information about building characteristics through our building operator interviews, versus the entire population of participants using information available through the program tracking data. To do so, we estimated savings for our interview sample using two approaches: (1) using all data we had collected through our interviews and program

[18] We developed building-specific energy models instead of running a single pooled model on all buildings because of how different participants were in terms of baseline consumption, program engagement, and data availability. This allowed us to produce more tailored parameter estimates for each model, and ultimately generate a more precise set of results.

[19] At the time of this evaluation, the program was still working on compiling hourly data for all participants. If available, future evaluations may be able to develop more precise impact results using this hourly data.

tracking data, and (2) only using data available in the program tracking data. After comparing the results from these two approaches, we determined that the additional information available for a small subset of interviewed participants did not compensate for overall loss in the number of observations (i.e., the total number of buildings) if we were to limit ourselves to only interviewed participants. Using only the subset of buildings for which we had additional data from the interviews presented additional challenges, as the interview subset did not have robust representation across all strata. For some strata, we would have had to extrapolate to the population of buildings using only a small number of sample points from the interview data. This was especially true for the less engaged strata, where it was more difficult to identify and complete interviews with building operators. Having less robust data from non-reporting customers could introduce bias into our results, as these customers are less likely to save energy. Thus, we did not pursue further analysis using the interview data. Moreover, for the most part, the data collected through our interviews did not provide important information about changes in building occupancy and usage that were not available through the Smart Energy HQ.[20] For more details, see Appendix A: Sample Versus Population.

When conducting the analyses, we developed site-specific analyses using the linear regression shown in Equation 1.

Equation 1. Site-Specific Linear Model Specification

$$ADC\ kWh_t = \beta_0 + \beta_1 Post_t + \beta_2 HDD_t + \beta_3 CDD_t + \beta_4(HDD * Post) + \beta_5(CDD * Post) + \beta_6 Occupancy_t + \beta_7(Occupancy * Post) + e_t$$

Table 4-1. Regression Model Variables and Parameters

Variable	Definition
$ADC\ kWh_t$	Average daily electricity consumption in month t
Post	Binary indicator equal to 1 in months building is participating in the program (aka enrollment date and after)
HDD	A measure of heating degree days for month t
CDD	A measure of cooling degree days for month t
Occupancy	The percentage of building occupancy during month t
B_o	Building-specific constant energy usage
B_2, B_3	Effect of heating and cooling degree days on average daily consumption
B_1	Effect of SEiO program participation on non-weather dependent energy consumption
B_4, B_5	Effect of SEiO program participation on how consumption varies with heating and cooling degree days
B_6	Effect of building occupancy on average daily consumption
B_7	Effect of SEiO program participation on how consumption varies with occupancy
$e_{i,t}$	Error term for customer i in month t

Note: An asterisk (*) indicates an interaction between two terms.

[20] For a few cases, we did use occupancy data collected through the interviews to fill in gaps or correct mistakes from occupancy data submitted by building operators in the Smart Energy HQ portal. Overall, only five cases contained information on non-routine adjustments that could be effectively modeled.

For each site, the evaluation team used the enrollment date to define when each building began to participate in the program. While not all accounts participated in a campaign immediately upon enrollment, the enrollment date demarcates when a participant has access to the Smart Energy HQ portal, and thus marks the earliest form of participation in the program.

In conducting the analysis, the evaluation team followed a number of best practices for conducting regressions on energy consumption data:

- **Controlling for weather:** Using the regression model specification above, we controlled for the effect of weather (using a measure of HDD and CDD) for each site-specific model.
- **Accounting for non-linear temperature dependence:** Acknowledging that building energy consumption does not vary linearly with temperature, we used a measure of heating degree days (HDD) and cooling degree days (CDD) to model each building's response to temperature. Further, we allowed the temperature change points to vary for each building (for example, one building may turn on its heating system when the ambient temperature is 65 degrees Fahrenheit; another building may not begin heating until the ambient temperature reaches 60 degrees Fahrenheit).[21]
- **Controlling for building occupancy:** Our models controlled for changes in building occupancy, to the extent possible. However, not all buildings had occupancy data available from program records or building operator interview results. Additionally, some buildings did not have *complete* occupancy data for all periods. For buildings that were initially missing more than 10% of the entries for occupancy, we relied instead on CoStar occupancy data.[22] In the final analysis, CoStar data was applied to 54 buildings that had previously been missing more than 10% of the monthly values for their occupancy data. After combining program tracking data, interview data, and CoStar data, occupancy was available for 150 buildings. We decided to include all buildings in our analysis, even if occupancy data was not available, as occupancy was not a critical variable for the buildings where we had it, and not including customers missing occupancy data (which were disproportionally less engaged customers, as they had not provided occupancy data as part of building operator campaign participation) would bias results. For more details, see Appendix A: Occupancy Data.
- **Accounting for pre-existing trends:** The evaluation team examined each building's pre-enrollment period data for evidence of trends of continuously increasing or decreasing consumption in the pre-enrollment period. For those buildings with a significant trend, we limited the effect of such trends by restricting the pre-enrollment observation period to the immediate 12 months prior to enrollment in SEiO. For more details in this, see Appendix A: Identification and Mitigation of Pre-Existing Consumption Trends.

To estimate savings, we used the site-specific regression models to predict energy consumption at the monthly level for each building in the post-enrollment period. The use of a "post" indicator variable, and interactions including the "post" term, allowed the models to predict how consumption changed in the post period. After estimating the models, we computed the change in consumption first at the monthly level by isolating the effect of the "post" term (plus any interactions with "post"). After computing the change in

[21] More specifically, we used a five-parameter change point model to estimate each building's response to ambient temperature. For more details, see Appendix A: Gross Impact Methodology.

[22] CoStar occupancy data was provided at the quarterly level. Since the billing analysis was conducted at the monthly level, we assume that the quarterly occupancy value applied to all months in that quarter.

consumption at the monthly level, we annualized this value by computing average values for each calendar month and summing these to one year's worth of consumption (a necessary step since some buildings had more than 12 months of post-period data).

The evaluation team applied several adjustments during the course of the regression analysis:

- **Examination of meter splits:** We conducted a thorough examination of irregular trends in meter read data working closely with Duke Energy and the implementation team to understand any meter splits or other changes in account structures over the evaluation period. Based on these efforts, we made several adjustments to ensure that we were using data from the correct accounts associated with participant in each month.
- **Insufficient pre-period data:** Buildings without at least 12 months of pre-period data were excluded from the analysis. This was done to ensure that all buildings had a sufficient number of billing observations to enable a good model representation.
- **Buildings with 0% occupancy:** Three buildings indicated a period of 0% occupancy at some point in the analysis period and were excluded from the analysis.
- **Models with negative occupancy coefficients:** There were 45 buildings where the coefficient on occupancy was negative in our initial models. This appears to be an omitted variable bias, with the occupancy term picking up some other changes within the building, as increasing occupancy should not decrease a building's electricity consumption. To avoid introducing bias, we constrained the occupancy coefficients to be non-negative in our final models.
- **Outliers:** Monthly energy consumption values that were outside three standard deviations from the mean consumption (for a specific building) were excluded from the analysis.
- **Energy savings from other programs:** After computing energy savings due to the SEiO program for each building, we subtracted any savings already claimed by that building through other Duke Energy programs (to avoid double-counting savings). We only considered savings from participation in other programs that occurred in each building's post-SEiO-enrollment period (i.e., savings accrued during a building's pre-enrollment period were not factored into this analysis).[23] Additionally, we accounted for *when* buildings amassed these savings by pro-rating the savings for the number of months that overlapped with the SEiO post-enrollment period.[24]

After applying these adjustments, annual energy savings were estimated at the building level and summed to produce a total program (annual) energy savings estimate. When aggregating building-level results, we took the following steps:

- **Accounting for program tenure:** While we estimated an annual savings value for each building, in actuality participants had varying levels of tenure in the program, from 12 to 30 months. The SEiO program is designed to result in continuous improvement in energy consumption over time. Because

[23] We applied evaluated realization rates to all savings from other energy efficiency programs.

[24] For instance, if a building's post-SEiO-enrollment period continued through February 2017, and this building had participated in another (non-SEiO) program in January of 2017, this means there were two months of overlap. If the first-year savings from the non-SEiO program was 1,200 kWH, only (2 months/12 months) * 1,200 kWH = 200 kWH was subtracted from the buildings SEiO savings value.

buildings in the billing analysis had varying lengths of program tenure, the evaluation team deemed it necessary to weight final savings values by the amount of time that each building had been involved with the program. The intent of this adjustment was to estimate what savings would look like had we been able to include the full three-year participation period for each building. To this end, buildings that had been involved for a longer period of time were given comparatively more weight in the final results, as program theory would suggest that these buildings would have had additional opportunity to achieve savings.

- **Accounting for savings from excluded buildings:** Because we had excluded a total of 11 buildings from the billing analysis based on insufficient pre-period consumption data, we applied the mean savings percentage from the appropriate stratum to each of these buildings in the final stratum-level and program-level savings calculations. Imputing a mean percent savings value for those cases for which we were unable to compute a site-specific savings value was the simplest way to account for these savings. Such a step was necessary to avoid underestimating the total savings from a stratum/program level.

4.1.3 Gross Demand Savings Calculation

To estimate demand savings, the evaluation team used the approach described in Equation 2. We used hourly billing data from Duke Energy to estimate a Peak-to-Average Ratio that is equal to a building's average demand during the peak period to the average demand throughout the rest of the year. We used this ratio to adjust our estimated average demand savings (total energy savings divided by 8,760 hours in a year) to more accurately represent participants' demand during the winter peak and summer peak times. The winter gross demand savings were calculated for all buildings for the hour ending at 8:00AM in the month of January. The summer gross demand savings were calculated for all buildings for the hour ending at 5:00PM in July.[25]

Equation 2. Site-specific Demand Savings Calculation

$$kW_t = \frac{kWh_t}{8760} * Peak\ to\ Avg\ Ratio_t$$

$$\text{where } Peak\ to\ Avg\ Ratio_t = \frac{Average\ Peak\ Demand_t}{Average\ Demand_t}$$

4.2 Gross Impact Results

In this section, we first present results on gross energy savings, then report on several additional analyses aimed at understanding the drivers of energy savings, and end with gross demand savings.

4.2.1 Results: Program Gross Energy Savings

Using the approach described in Section 4.1 above, we estimated savings for each participating building and aggregated savings to the stratum- and program-level, as summarized in Table 4-2. Results are shown as the average annual change in consumption, both in kWH and as a percentage of baseline consumption,

[25] We used this approach because there was not sufficient baseline hourly data to compare the differences in peak demand pre- and post-participation.

meaning that energy savings are represented as negative differences in predicted consumption. We report program-level results separately for SEN pilot participants and non-participants, since the differences in the treatment the SEN participants have received (both from SEN itself as well as Envision Charlotte) mean that results from this group may not be comparable to savings expected from non-SEN (and thus non-Envision Charlotte) participants. Overall, we found that SEN participants saved 5.0% of their baseline energy usage annually, which was statistically significantly different than zero (the 90% prediction interval is from -8.1% to -1.5%). However, we could not detect savings amongst non-SEN participants, whose consumption decreased -0.3% on average, (with a 90% prediction interval from -1.7% to +1.4%).

Table 4-2. Gross Impact Results –Changes in Average Annual Energy Consumption by Stratum

Stratum			Billing Analysis N	Total N[a]	Average Annual Change in Consumption Before Adjusting for Other EE Savings (%)[b]	Average Annual Change in Consumption After Adjusting for Other EE Savings (%)[b]	Average Annual Change in Consumption After Adjusting for Other EE Savings [b]	
							%	kWH
Non-SEN	Large	Engaged (#1)	42	44	-1.3%	-0.6%	-0.3% (90% Prediction Interval: -1.7% to +1.4%)	-1,039,628
		Non-reporting (#2)	12	13	-3.0%	+1.6%		
	Small	Engaged (#3)	55	59	-2.1%	-0.4%		
		Non-reporting (#4)	30	33	-8.0%	-5.4%		
SEN	All	Engaged (#5)	14	19	-6.4%	-5.2%	-5.0% (90% Prediction Interval: -8.1% to -1.5%)	-14,684,033
		Non-reporting (#6)	10	10	-6.0%	-4.6%		

a. The number of buildings shown in this column includes those buildings that were excluded from the analysis because they did not have at least 12 months of pre-enrollment period data.
b. Negative values indicate savings.

As shown in Table 4-2, savings varied across strata. Predicted savings values were high among customers who had also participated in the SEN pilot (strata #5 and #6), regardless of whether or not they had been engaged in the SEiO program (although savings were slightly higher amongst engaged customers). Among participants who had not been SEN pilot participants, the role of engagement was mixed: both large engaged buildings (stratum #1) and small engaged customers (stratum #3) were more likely to achieve savings than large non-reporting counterparts, while small non-reporting, non-SEiO participants did save energy as a group after accounting for other Duke Energy energy efficiency program savings.

To compare results to how ex ante savings values were calculated, we also show savings by a slightly different grouping structure in Table 4-3. This classification ignores the “engaged” vs. “non-engaged” distinction that was used for our data collection sampling. These results show that large SEN participants were more likely to exhibit savings compared to their non-SEN counterparts. Among small buildings however, the reverse trend was true, with non-SEN customers predicted to have a slightly greater change in consumption compared to SEN customers. These results reinforce the evaluation team’s position that SEN

participants received what is effectively a different type of treatment (which is also dependent on building size), and should be considered separately when assessing energy savings.

Table 4-3. Gross Impact Results – Percent Change in Average Annual Energy Consumption by Group

Group		Billing Analysis N	Total N[a]	Average Annual Change in Energy Consumption Before Adjusting for Other EE Savings	Average Annual Change in Energy Consumption After Adjusting for Other EE Savings
Large	Non-SEN	53	56	-2.1%	+0.4%
	SEN	18	23	-5.9%	-5.1%
Small	Non-SEN	86	93	-2.1%	-1.8%
	SEN	6	6	-1.7%	-1.7%

a. The number of buildings shown here includes those buildings that were excluded from the analysis because they did not have at least 12 months of pre-enrollment period data.

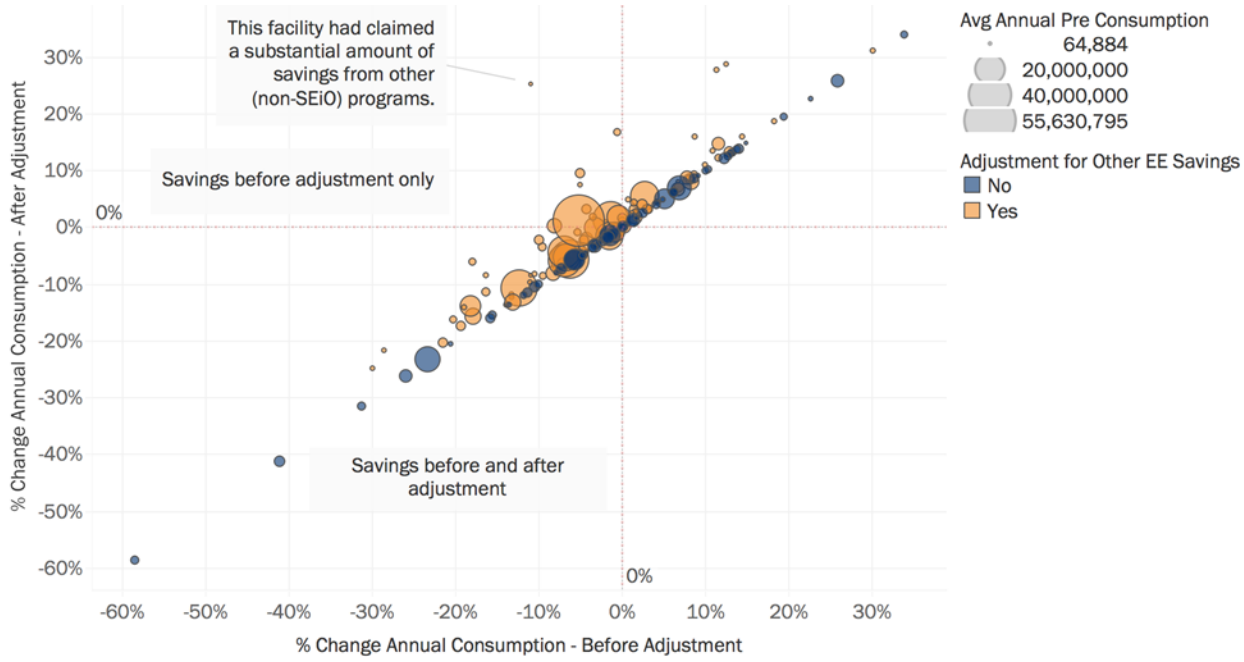
4.2.2 Comparison of Energy Savings Estimates Before and After Adjusting for Savings from Other Non-SEiO Programs

As shown in Table 4-2 and Table 4-3, participants in every stratum saved energy on average *before* we accounted for savings claimed through other Duke Energy energy efficiency programs. Because these savings have already been claimed through other programs, we have adjusted our SEiO savings estimates to prevent double-counting savings. A graphical depiction of how this affected the results is shown in Figure 4-1. The majority of buildings claiming savings from other programs (shown in orange) experienced a relatively small change in estimated savings for SEiO after we adjusted for other program savings. However, a handful of buildings had claimed a large amount of non-SEiO program savings;[26] as a result, SEiO savings for these decreased substantially after this adjustment was made. In sum, these adjustments do have a significant effect on lowering estimated savings, especially for non-SEN participants.

It is important to note that SEiO may still be responsible for generating the savings claimed through other energy efficiency programs, if the program provides participants with the data and information needed to complete capital projects. This evaluation is not able to quantify the extent to which SEiO helped drive participation in Duke Energy's other programs. Given the amount of savings being claimed through other Duke Energy programs, however, future evaluations should seek to understand whether any of these savings are attributable to SEiO.

[26] Non-SEiO programs from which SEiO participants had claimed savings included: Custom Incentive, Small Business Energy Saver, SmartSaver Non-Residential Prescriptive, and SAW SmartSaver Custom.

Figure 4-1. Comparison of Savings Before and After Adjusting for Savings from Other (Non-SEiO) Programs

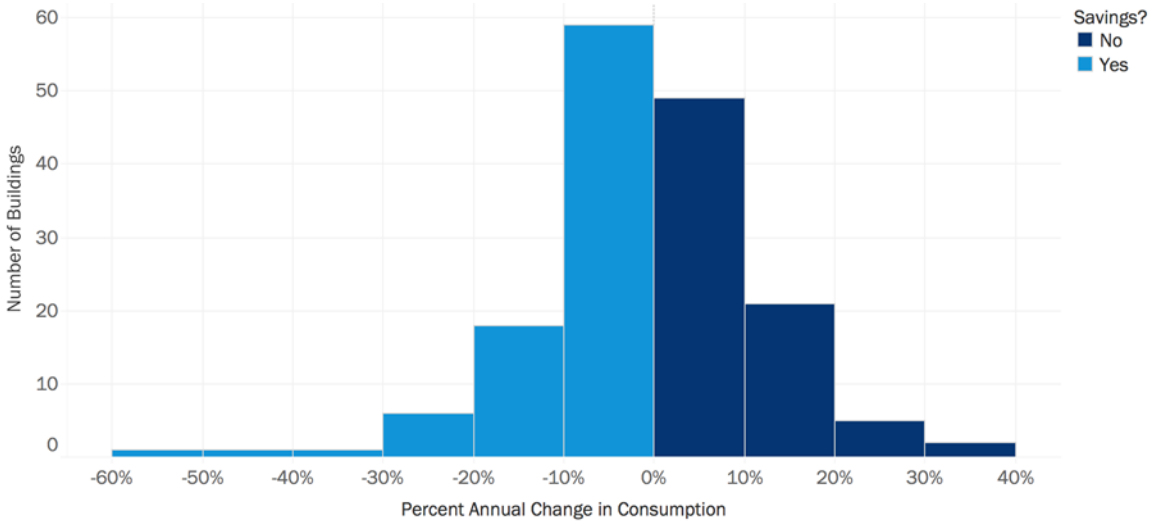


*In this figure, savings are shown as a negative consumption.

4.2.3 Distribution of Energy Savings After Adjusting for Non-SEiO Savings

Savings were not evenly distributed across all buildings. As shown in Figure 4-2, there was a wide range of estimated changes in consumption due to SEiO program participation. As might be expected, most buildings fell within the range of -10% to +10%; however, a number of buildings fell outside this range.

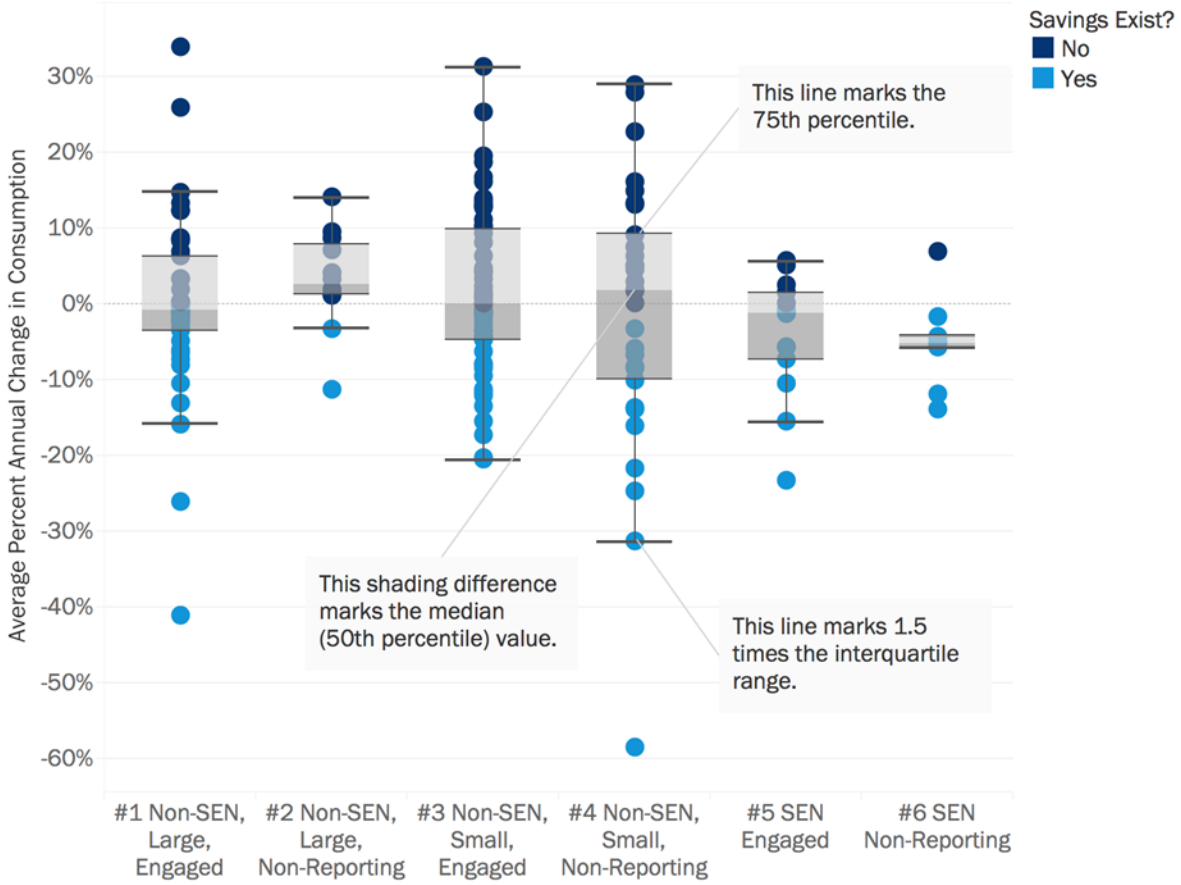
Figure 4-2. Distribution of Savings Across Buildings After Accounting for Other (Non-SEiO) Savings



*In this figure, savings are shown as a negative change (decrease) in annual consumption.

Within each stratum, there was variability in the estimated percent change in consumption resulting from SEiO participation. As shown in Figure 4-3, there appeared to be greater variability within the non-SEN strata (#1 through #4) than in the SEN strata (#5 and #6).

Figure 4-3. Distribution of Savings by Stratum (After Adjusting for Non-SEiO Savings)



*In this figure, savings are shown as a negative change (decrease) in annual consumption.

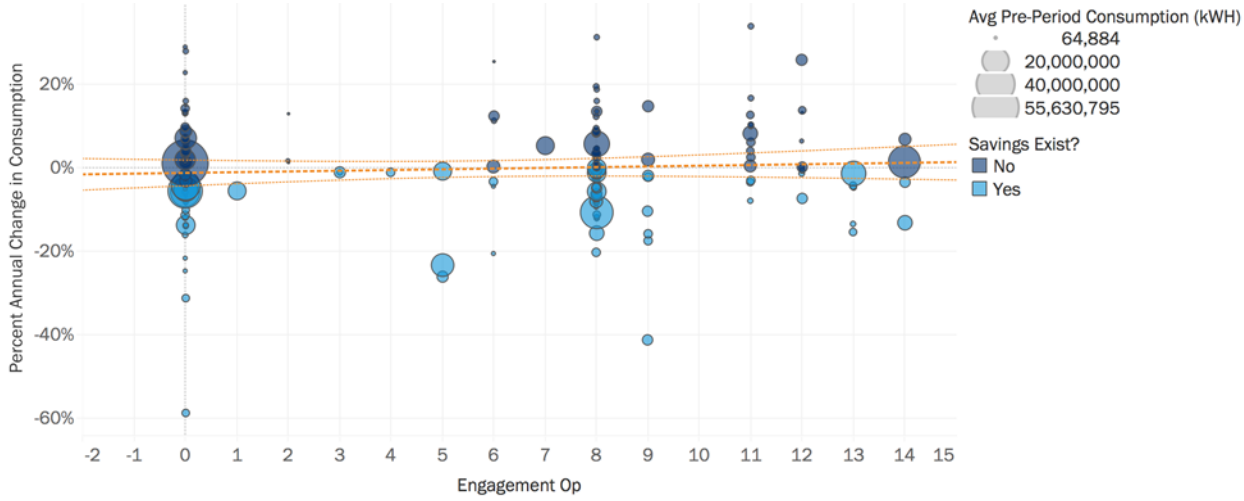
4.2.4 Drivers of Energy Savings

The evaluation team conducted several additional exploratory analyses to better understand precisely how the program may be driving energy savings. These analyses focused on (1) the relationship between energy savings and the number of operator campaigns; (2) the relationship between energy savings and length of tenure in the SEiO program; and (3) the relationship between energy savings and baseline energy use intensity. We discuss each of these in turn in the following section.

We first tested the hypothesis that participation in a greater number of operator campaigns might be associated with greater relative energy savings. However, as seen in Figure 4-4, although visually suggestive, this relationship was not significant ($p = 0.41$). In other words, there appeared to be little correlation between the number of campaigns in which a building participated and the magnitude of estimated energy savings for that building. One possible reason for this is that we do not have good information on the *quality* of participation in a campaign. In other words, we cannot easily tell if the campaign resulted in changes in behavior. Thus, simply looking at the number of campaigns may not capture the details that are important

for understanding whether or not a campaign is likely to achieve savings. Looking at this question from a different angle, we examined the relationship between energy savings and the number of operator award points earned at each building and found no relationship (p = 0.99). We hypothesize this is because operator points are based on the number of questions answered and not on actual changes in behavior (e.g., an operator may answer a question indicating that they are already performing an activity and still receive points). We also looked at whether savings varied by tenant challenge participation and use of building benchmarking services. Neither of these interventions were correlated with savings, as detailed in Appendix B: Additional Regression Analysis: Savings Drivers.

Figure 4-4. Trend Between Savings and Number of Operator Campaigns

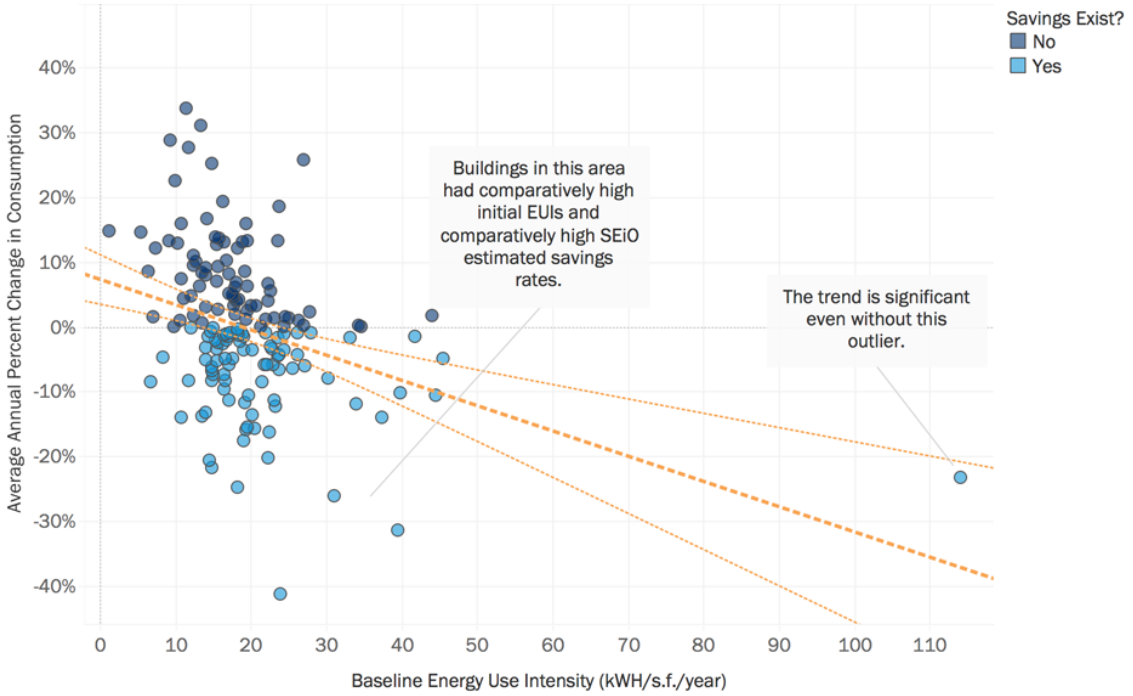


*In this figure, savings are shown as a negative change (decrease) in annual consumption

We observed no detectable relationship between energy savings and length of program tenure. Specifically, we found no significant relationship overall between the magnitude of energy savings resulting from participation in the SEiO program and the length of tenure in the program (p = 0.85). This relationship between length of tenure and en ergy savings was also not significant for engaged buildings (p = 0.96) or for non-reporting buildings (p = 0.85). The relationship approaches marginal significance for buildings that participated in the SEN pilot (p = 0.13) but not for those buildings that did not participate (p = 0.45).

The evaluation team also explored the effect that baseline energy use intensity (EUI, measured in kWH per square foot per year) may have on a building's likelihood of saving energy as a result of SEiO participation. Figure 4-5 shows that there is a significant (p < 0.001) and meaningful trend between baseline EUI and energy savings. This suggests that buildings with a higher baseline EUI are more likely to achieve savings through participation in SEiO. It is difficult to say exactly why this is the case. However, one possible explanation is that buildings with a higher baseline EUI have more savings potential to work with, or have more intrinsic motivation to pursue energy savings. Another explanation is that buildings with a higher baseline EUI simply have not been proactive in managing their energy use, and thus a program like SEiO is able to have an immediate and measurable impact (particularly because small changes may have big impacts). Either way, this finding supports the notion that buildings with higher EUIs may also have higher savings potential.

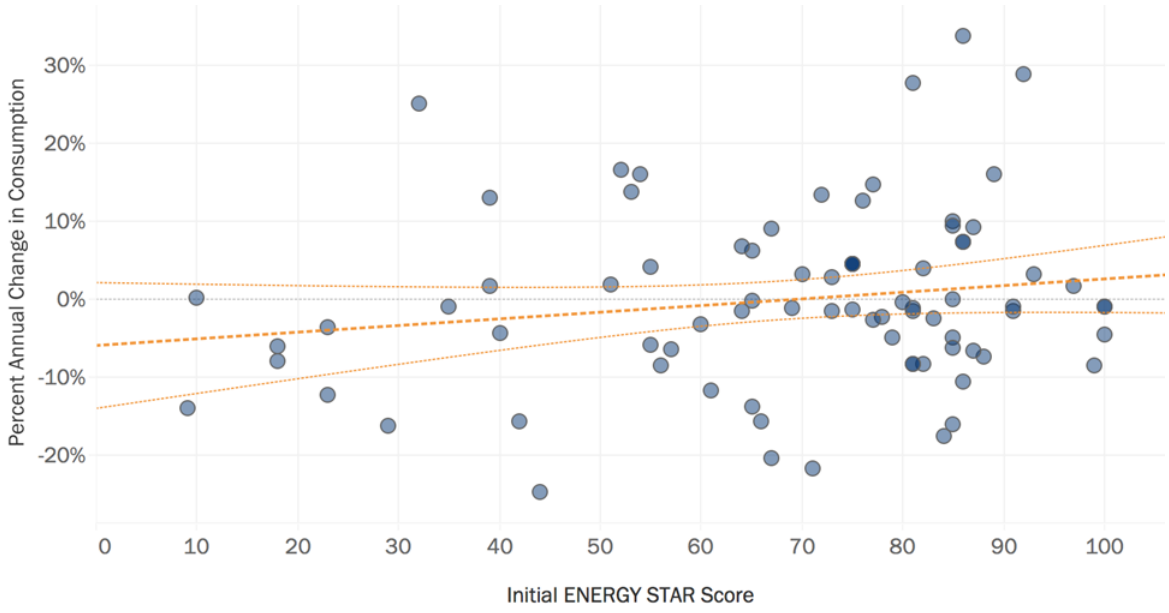
Figure 4-5. Trend Between Change in Average Annual Energy Consumption and Energy Use Intensity



*In this figure, savings are shown as a negative change (decrease) in annual consumption

The notion that a higher initial estimated EUI is correlated with a greater savings value potential is further supported by the finding that a building's estimated savings is *inversely* related to its initial ENERGY STAR score (Figure 4-6). The logic behind these findings is simple: buildings with a higher EUI and a lower ENERGY STAR score—if they can be meaningfully engaged—may be more likely to yield savings through the program.

Figure 4-6. Trend Between Change in Savings and Initial ENERGY STAR Score



*In this figure, savings are shown as a negative change (decrease) in annual consumption

The evaluation team performed regression analysis on several additional variables to see if other significant drivers of savings existed; this regression analysis is included in Appendix B: Additional Regression Analysis: Savings Drivers.

4.2.5 Case Studies

While we were not able to identify many statistically significant drivers of energy savings beyond baseline EUI, we were able to identify qualitative differences in savings using results from our data collection with building operators. Below we highlight the experience of two building operators with very different experiences, to illustrate what types of customers may save through the program.

First, consider Operator A, who participated in a total of 14 operator campaigns. Out of these 14 campaigns, Operator A said that seven of the campaigns caused him to start new monitoring/verification activities and four caused him to increase the level of effort on existing monitoring/verification practices (see Section 6.3.3 Operator Campaign Efficacy and Outcome Persistence for more details on these questions).[27] Through our billing analysis, we estimated that Operator A's building achieved a 4% savings through the SEiO program.

Conversely, Operator I participated in seven campaigns, but reported that the campaigns led to no changes in his monitoring/verification practices. In our regression analysis, we estimated that Operator I's building's consumption increased by +15% change during the program period.

[27] The building operator was not asked about the remaining three campaigns.

While we cannot generalize from these examples, they do suggest that the program may be more effective when building operators are not already implementing efficient monitoring/verification activities. Moreover, these examples underscore the importance of targeting and capturing the *quality* of changes in behavior during a campaign, rather than just the *quantity* of questions that an operator answers through a campaign.

4.2.6 Results: Program Gross Demand Savings

In addition to calculating gross energy savings, the evaluation team also estimated gross demand savings for the program, including a winter seasonal demand savings and a summer seasonal demand savings. The winter and summer peak-to-average ratios represent the ratio of the winter and summer peak demand (respectively) to the total average annual demand. These values are shown below in Table 4-4. (Consistent with previous tables, savings are represented as a negative value.)

Table 4-4. Gross Impact Results – Peak-to-Average Ratio and Program-Level Demand Savings

Season	Peak-to-Average Ratio
Winter	1.20
Summer	1.14

We estimated demand savings for each stratum, as shown in Table 4-5. Similar to the pattern seen with energy savings, greater demand savings was associated with SEN participants (#5 and #6) as well as with large engaged customers (#1) and small non-reporting customers (#4).

Table 4-5. Gross Impact Results – Demand Savings by Stratum

Stratum			Billing Analysis N	Total N[a]	Summer Demand Savings (kW)	Winter Demand Savings (kW)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Non-SEN	Large	Engaged (#1)	42	44	-102	-107	119	125
		Non-reporting (#2)	12	13	267	281		
	Small	Engaged (#3)	55	59	65	68		
		Non- reporting (#4)	30	33	-111	-117		
SEN	All	Engaged (#5)	14	19	-804	-847	-1,511	-1,590
		Non- reporting (#6)	10	10	-706	-743		

a. The number of buildings shown in this column includes those buildings that were excluded from the analysis because they did not have at least 12 months of pre-enrollment period data.

5. Net-to-Gross Analysis

This section describes our approach for estimating the net-to-gross ratio (NTGR) for the SEiO program and presents the resulting NTGR and the program net impacts. The NTGR at the program level is calculated as the average NTGR of survey respondents weighted by annual electric consumption in the pre-participation period. The net savings for an individual account is its gross savings multiplied by its NTGR. The following subsection describes the free-ridership calculation methodology.

5.1 Methodology

Our net-to-gross (NTG) analysis is based on estimating participants' free-ridership (FR). Spillover is not included in the NTG analysis as any spillover savings within a participating building would be captured through the gross savings billing analysis. The NTGR is calculated as follows:

$$NTGR = 1 - FR$$

The free-ridership of each respondent is estimated based on self-reported responses to questions regarding what the participants would have done in the absence of the program. The program's theory, logic, and design suggests free-ridership should be very low to nonexistent in most cases, both because financial incentives are not provided to participants and because it is not possible to implement most program interventions (i.e. the specific campaigns and challenges) without participating in the program. Free-ridership, then, requires that the participant organization would have taken actions to encourage building operators and/or occupants to save energy in *similar ways to those targeted by the program campaigns.* Furthermore, simply continuing to implement the practices encouraged by the interventions does not constitute free-ridership because there would be no gross savings associated without a change in activity. As such, our free-ridership approach requires consistent and strong evidence that the customer would have *started* taking similar actions around the time they enrolled in the program.

To understand free-ridership using this approach, respondents were first asked whether participating in each campaign changed how they implemented the targeted behavior or practice. If respondents reported making a change, we then asked them about the magnitude of the change and whether they would have made similar changes in the absence of the campaign.[28] If respondents reported that they would have made similar changes as those targeted by a campaign, they were then asked about how effective those changes would have been and when they would have occurred.

The responses from this survey were used to calculate a building-level FR score for: (1) each individual operator campaign; (2) benchmarking; and (3) tenant engagement overall. The final building-level free-ridership score was calculated as the simple average of each operator campaign, benchmarking, and tenant engagement free-ridership score. To estimate the program-level FR score, we first assigned each building a FR score of zero if that building had experienced negative savings (i.e., consumption had increased after participating in SEiO) and then weighted each building's score by its pre-period consumption.

To understand whether there was potential spillover worth quantifying in future evaluations, we asked building operators about whether insights from SEiO prompted them or their organizations to save energy in

[28] Because there is no direct substitute for participating in a campaign (customers would not run a program-campaign outside of SEiO), respondents were asked about the main actions targeted through the campaign, rather than the campaign themselves.

other ways than those encouraged by the programs, including at home, in other buildings, and in purchasing new equipment. Overall, only one operator responded affirmatively, indicating he used benchmarking results to justify capital investments in energy efficiency.

5.1.1 Operator Campaigns

We calculated a building-level FR score for each operator campaign based on two parameters: (1) actions taken in the absence of the program (Actions sub-score) and (2) timing of actions taken in the absence of the program (Timing sub-score). These sub-scores were assigned values of 0, 0.5, and 1. Table 5-1 shows the definitions of each of these sub-scores.

Table 5-1. Building Operator Free-ridership Campaign Sub-score Definitions

Score Value	Actions	Timing
0	Did not have specific plans to take similar actions to encourage operators to save energy	Plans would have been more than a year from enrolling in the program or unknown timeframe
0.5	Had specific plans to encourage operators to save energy through comparable efforts to the SEiO campaign, but the efforts would have been less effective	Plans would have been six months to a year from enrolling in the program
1	Had specific plans to encourage operators to save energy through comparable efforts to the SEiO campaign, and the efforts would have been equally or more effective	Plans would have been within 6 months of enrolling in the program

The building operator FR score for each campaign was calculated as the product of the Actions and Timing sub-scores. Questions pertaining to the Timing sub-score were not asked to respondents who received an Actions Score of 0, resulting in a campaign-level FR score of 0. Table 5-2 shows the possible campaign-level FR scores based on the Actions and Timing sub-scores.

Table 5-2. Building Operator Free-ridership Scores by Actions and Timing Sub-scores

		Timing		
		0	0.5	1
Actions	0	0	0	0
	0.5	0	0.25	0.5
	1	0	0.5	1

5.1.2 Tenant Challenges

We calculated a building-level FR score for tenant challenges based upon two parameters: (1) actions taken in the absence of the program (Actions sub-score); and (2) timing of actions taken in the absence of the program (Timing sub-score).

For tenant challenges, the Actions sub-score was based on whether coaches reported that the respondent's organization (1) would have encouraged the same actions targeted by the challenge; and (2) used comparable behavioral strategies to encourage these actions (such as reminders, competition, commitment,

and recognition). For each challenge, we created a set of *action-strategy pairs*, which described each method used to encourage each action targeted by the challenge. If customers responded that they would have encouraged an action in the absence of the program, we then asked which of the program's behavioral strategies they would have used. If they responded that they would have used one of the program's method, then they were scored as a one on that action-strategy pair. We required the respondent to say they would have used one of the program strategies to encourage the targeted behavior change to ensure that the organization had *specific plans* to target a behavior in the absence of the plan. The Actions sub-score is the percent of action-strategy pairs the customer reported that they would have targeted in the absence of the program compared to the total number of action-strategy pairs targeted by the actual program. For example, the Butterfly Effect challenge targeted four actions, each of which were promoted using reminders, competition, commitment, and recognition, creating a total of 16 action-strategy pairs. If a respondent planned to use competition and recognition to encourage customers to turn off lights but not the challenge's three other actions (dressing in layers, unplugging chargers not in use, turning off computer monitors not in use), then they would be assigned an action score of 2/16=0.125.[29]

The timing sub-score for tenant challenges is described in Table 5-3 below. Because the two tenant challenges covered in the survey were offered within a couple months of each other, we simplified the timing question for participants by phrasing the timing options in terms of calendar years (2016, 2017) rather than the more general time periods (six months, one year) used for the building operator campaigns (which could have been implemented at any time). Finally, the final tenant engagement FR score for each challenge is the product of the Actions sub-score and Timing sub-score.

Table 5-3. Free-ridership tenant challenge timing sub-score definition

Timing Score Value	Timing
0	Plans would have been after 2017 or an unknown timeframe
0.5	Plans would have been in 2017
1	Plans would have been in 2016 or earlier

5.2 NTG Results

We estimate the program-level NTGR for the DEC SEiO program to be 90.5%. This results in a total annual net savings value of 13,007,257 kWh. This calculation is performed according to below:

Equation 3. Equation Used to Calculate Net Savings

$$Total\ Net\ Savings = \sum_i \Delta Net\ Consumption_i$$

where: $\Delta Net\ Consumption_i = \begin{cases} Reduction\ in\ consumption: Building_i\ \Delta consumption * .905 \\ No\ reduction\ in\ consumption: Building_i\ \Delta consumption \end{cases}$

[29] The action-strategy pairs of lights-competition and lights-recognition would each receive a score of 1, while the remaining 14 action strategy scores (lights-reminders, lights-commitment, monitors-competition, monitors-recognition, monitors-reminders, monitors-commitment, etc.) would each receive score of 0, for a total of 2 out of 16.

5.2.1 Free-Ridership

A total of nine participants provided valid responses to the FR questions in the participant survey and were included in the FR analysis.[30] Using the algorithm summarized in Section 5.1 above, we estimated program-level FR to be 9.5%. We did not find observable differences between individual program interventions, but differences between respondents did exist.

Free-Ridership by Respondent

The median respondent-level free-ridership score was 4%, with scores ranging from 0% to 88%. Table 5-4 shows that four of the nine respondents reported zero free-ridership, while only a single score was over one-third.

Table 5-4. Average Free-Ridership Score and Net-to-Gross Ratio by Respondent

Respondent	FR	NTGR	Interventions
1	0%	100%	8
2	0%	100%	8
3	0%	100%	7
4	0%	100%	6
5	4%	96%	8
6	8%	92%	12
7	9%	91%	12
8	33%	67%	14
9	88%	12%	13

Consistent with SEiO program theory, free-ridership is very low for the program. The single respondent with a free-ridership score of 88% reported that his organization was hired to operate and manage the building around the time it was enrolled into the program, and the organization was planning on implementing many operations activities that were similar to those encouraged through SEiO's building operator campaigns.

Free-ridership was higher for operators who had completed more campaigns. This may imply that operators who complete most or all program campaigns may end up doing more campaigns that target actions they would have taken in the absence of the program. This is consistent with the idea that that some building operators are already implementing some of the actions being promoted by the program, as described in Section 6.3.3 Operator Campaign Efficacy and Outcome Persistence.

Free-Ridership by Intervention

Intervention-level free-ridership estimates ranged from 0% to 45%, as shown in Table 5-5. However, not all respondents implemented each campaign; the number of respondents to implement each intervention ranged from one to eight. While there was some variability, we do not see any meaningful or significant differences in free-ridership score across campaigns.

[30] One survey respondent was excluded from the FR analysis due to incomplete responses to key FR questions.

Table 5-5. Average Free-Ridership Score and Net-to-Gross Ratio by Intervention

Interventions	FR	NTGR	N
Where You at Thermostat?	0%	100%	8
Benchmarking	0%	100%	3
Tenant Challenges	0%	100%	1
Wiser Economizer	3%	97%	6
Damper Derby	5%	95%	8
Set-point Summit	5%	95%	8
Clean Sweep	5%	95%	5
All about that BAS	5%	95%	7
Performance Pit Stop	6%	94%	8
How Low Can You Go	10%	90%	5
Shake Up Your Wake-up	17%	83%	8
Watts with the Weather	21%	79%	5
Coasting Time	32%	68%	7
Go with the Flow	32%	68%	6
Let It Go	45%	55%	3

5.3 Net Impact Results

Using this NTG approach, gross and net energy savings by stratum are shown below in Table 5-6.

Table 5-6. Gross and Net Savings by Stratum

Stratum			Billing Analysis N	Total N[a]	Gross Energy Savings (kWH)	Net Energy Savings (kWH)
Non-SEN	Large	Engaged (#1)	43	44	-977,276	-442,984
		Non-reporting (#2)	12	13	1,525,999	1,554,995
	Small	Engaged (#3)	56	59	-244,532	-3,856
		Non-reporting (#4)	31	33	-1,343,820	-1,108,177
SEN	Both	Engaged (#5)	14	19	-9,282,068	-8,199,298
		Non-reporting (#6)	10	10	-5,401,964	-4,807,937

a. The number of buildings shown in this column includes those buildings that were excluded from the analysis because they did not have at least 12 months of pre-enrollment period data.

6. Process Evaluation

6.1 Researchable Questions

This section presents the findings from the process evaluation of the Smart Energy in Offices program for DEC. The process evaluation focused on program processes, customer satisfaction with the program, barriers to participation, and opportunities for program improvement. Process-related research questions included:

- How do participants become aware of the program?
- Why do participants decide to enroll in the program and participate in campaigns?
- What keeps some building owners and managers from participating fully in the program?
- Why do participants decide not to participate in various campaigns?
- How satisfied are stakeholders with the program? With each intervention?
- How much do participants value the various program elements targeted at building owners and operators, such as the building operator campaigns, automated building benchmarking, operator forums, and awards/recognition? What modifications could improve the experience and increase engagement?
- How much do participants value the various program elements targeted at tenants, such as information about building energy usage or competitions? What modifications could improve the experience and increase engagement among tenants?
- How much do participants value the communication and feedback channels available through the program, such as the Smart Energy HQ, the Happen App, email outreach and direct communication with program staff? Do participants have any recommendations for improving communication?

6.2 Methodology

The process evaluation relied primarily on the program staff interviews, program data review, building operator and coach interviews and follow-up surveys, and tenant surveys. Each of these activities is described in more detail in Section 3.

6.3 Key Findings

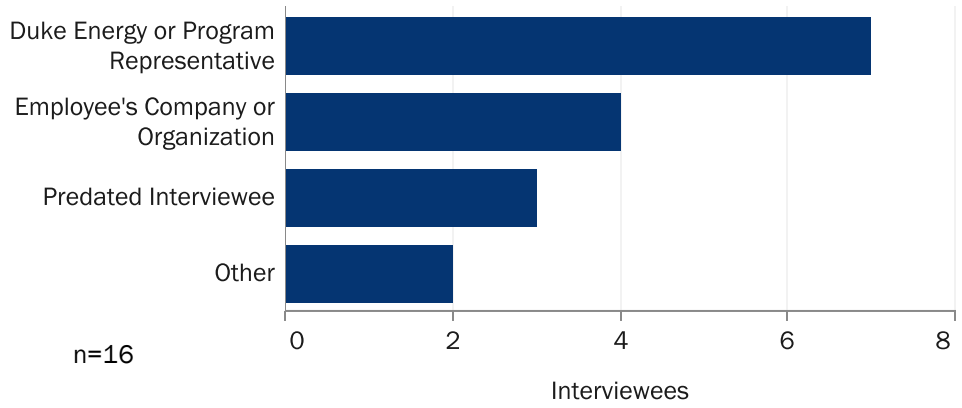
This section provides detailed findings from the SEiO process evaluation, starting with sources of awareness and motivations. Next, after providing an overview of participants' satisfaction with the program, we provide details on the various components of the program, including building operator campaigns, tenant campaigns, benchmarking, the Smart Energy HQ, and program staff.

6.3.1 Sources of Awareness and Motivations

SEiO is marketed to mid- and large-sized offices primarily through direct outreach to customer contacts. Sources of awareness identified by building operators and coaches are consistent with this outreach

approach, with a plurality learning about the program directly from a Duke Energy or SEiO program representative (n=7), as shown in Figure 6-1.

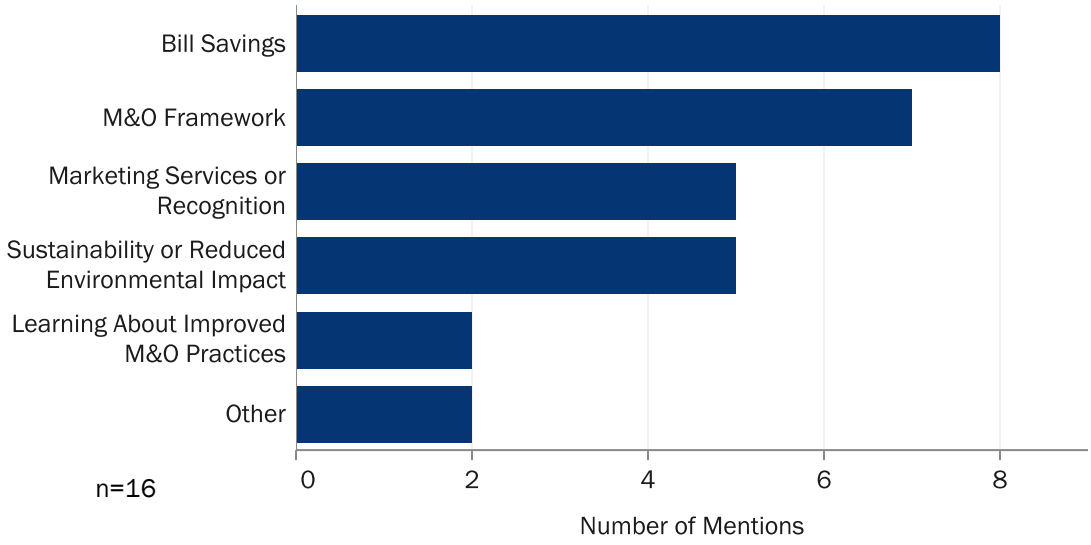
Figure 6-1. Building Operator and Coach Initial Source of Awareness



Other sources of awareness included hearing about the program from another person in the employee's company or organization (n=4), or when beginning to work for their organization (that is, the organization's participation predated the interviewee's employment (n=3). For both of these responses, interviewees indicated in many cases that another individual at their organization or their predecessor found out about the program directly from a Duke Energy or program representative. One respondent indicated that she was previously involved in the SEN pilot but could not remember how she initially became aware of the pilot, and another contacted Duke Energy in order to inquire about building energy benchmarking and was directed to the SEiO program.

The evaluation team also asked SEiO coaches and building operators about what motivated them and their organizations to participate in the program. These questions were open-ended, and interviewees were able to mention multiple motivations. Figure 6-2 summarizes interviewees' motivations for participating in SEiO, with more details on these responses provided below.

Figure 6-2. Building Operator and Coach Participation Motivations



Half of the interviewees (n=8) mentioned saving money on their energy or utility costs as their reason for participating. Interviewees who mentioned bill savings included those who served as building operators, coaches, and both. One interviewee described:

> *"Fundamentally, it comes down to operating costs. … It's a benefit to everyone if our operating costs are low. That helps with leasing and retaining tenants, and it makes the landlord [owner] happy."*

Other responses in this category included references to "bills," "expenses," or "bottom line."

After bill savings, interviewees most frequently mentioned motivations related to SEiO being a maintenance and operations (M&O) framework (n=7). In these responses, respondents typically described the program as encouraging work that building operators are or should already be doing. As one interviewee described: "Everything that has been asked through the Smart Energy in Offices program is already being done through our preventative maintenance program. So, it's just like another check system to … make sure all of our systems are operating efficiently." Note that responses in this category did not attribute any *new* M&O activities to SEiO, but generally recognized the value of having a framework to make sure established M&O practices were not overlooked.

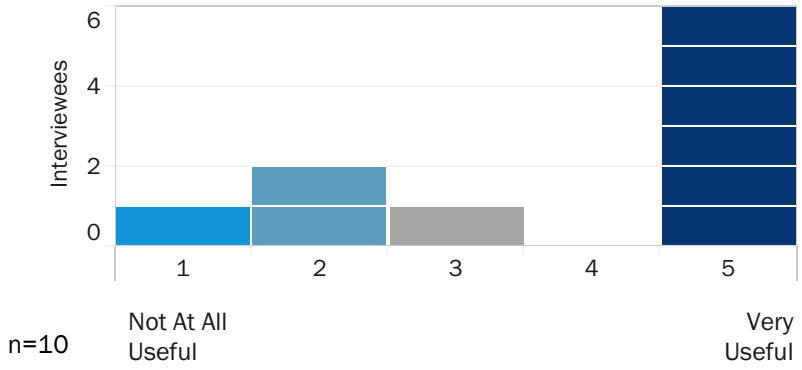
Notably, two operators mentioned the related but distinct motivation of learning about *improved* M&O practices (n=2). In these responses, interviewees actually mentioned increasing or improving M&O activities in their buildings. For example, one interviewee reported: "I would say that … 70% of what we do in the operator campaigns we already do internally, but there's a 30% … that brings value to us and our program that we provide to our client." In contrast to "M&O Framework" responses, this is a stronger statement suggesting that SEiO helped the organization add *additional* M&O activities to their practices. Note that these responses are only relevant to building operators, but taken together, M&O-related motivations were mentioned most frequently.

Interviewees mentioned using the program to promote environmental sustainability and to market or gain recognition for their M&O practices equally often (n=5). Interviewees who mentioned environmental sustainability as a motivation often referred to environmental concerns or reducing impacts generally. One interviewee described her organization's sustainability initiative: "We're very into trying to be green and several of our buildings … have LEED Certification … Being energy efficient and responsible operators is important for us."

Building operators also mentioned motivations related to marketing their energy management services to prospective clients (e.g., commercial real estate owners) or receiving recognition for energy management efforts from their own organizations. One interviewee, an operator, explained his organization's motivations: "[My company wants] to be able to showcase what us engineers can do. We can get more office buildings. It's a very good marketing tool." Another interviewee, a coach, described: "On the building campaign leaderboards, we got an email a couple months ago that [said] we were number 5, and then last month, we [got] an email that we were number 2 … We were glad to see that, and it gave us an opportunity to brag about our facilities' teams … That was very helpful." These responses did not always reflect the view that the program is causing energy savings, but rather that the value of the program was in documenting and benchmarking the benefits of existing M&O practices, such as maintaining a high ENERGY STAR score.

The evaluation team also asked interviewees to rate the usefulness of various aspects of the program, including the recognition they received through the program. Consistent with this commonly-cited motivation, six of ten interviewees rated this recognition as "very useful," a five on a one-to-five scale, as shown in Figure 6-3. While not all interviewees found recognition for participating in SEiO useful, recognition for participation efforts emerged as an important motivator and a useful aspect of the program for many participants.

Figure 6-3. Building Operator and Coach Usefulness of Recognition



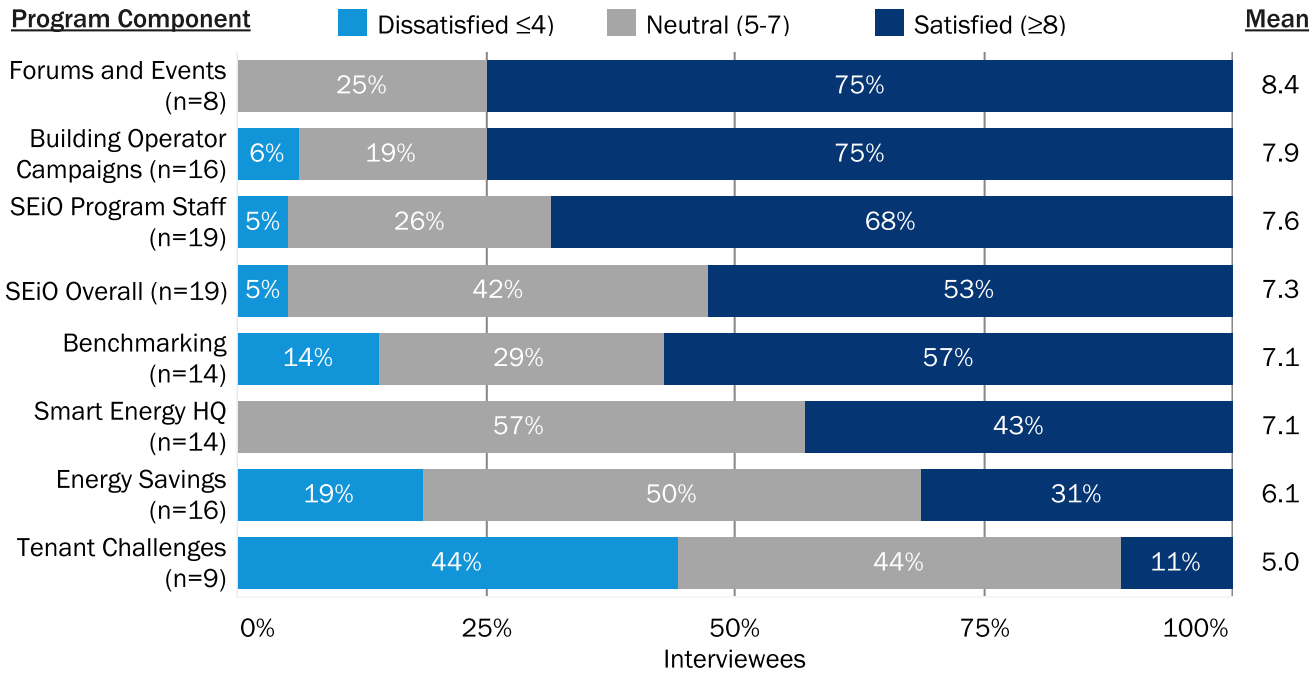
According to feedback gathered by program staff, saving energy was not the key motivation for operators to engage in the program. However, management of energy costs is an important metric by which building operators' performance is assessed, so saving energy is an important motivation to the extent that it improves their professional performance and operators can receive recognition for their accomplishments.

6.3.2 Program Satisfaction Overview

To introduce our detailed findings, this section first provides an overview of building operators' and coaches' satisfaction with the program. These findings are explored in more detailed throughout the remainder of this report.

Figure 6-4 summarizes these results, with each program component shown by the percentage of responses indicating satisfaction (≥8), neutrality (5–7), and dissatisfaction (≤4). Overall, operators and coaches were generally satisfied with the SEiO program, though some areas of notable dissatisfaction exist.

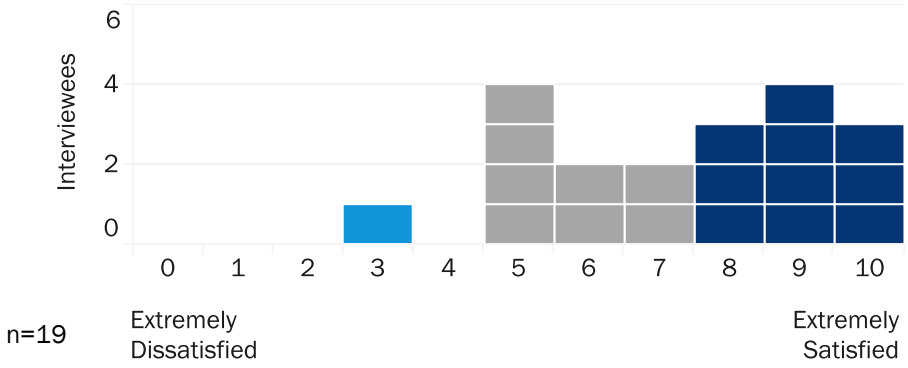
Figure 6-4. Building Operator and Coach Satisfaction with SEiO and Program Components



The mean rating of most program components, as well as the program overall, was between six and eight, indicating moderate satisfaction with the program. Exceptions include satisfaction with building operator forums and events (8.4, n=8) and tenant challenges (5.0, n=9); relatively few interviewees were able to give ratings for these program components, so these results should be interpreted cautiously. These satisfaction ratings will be discussed and contextualized in additional detail in the following sections.

Figure 6-5 shows the distribution of satisfaction ratings for the SEiO program overall. While over half (53%) of respondents rated the program as eight or higher, five (exactly "neutral") was chosen equally often as nine. This finding is consistent with ambivalence toward various aspects of the program, as discussed in the following sections. However, dissatisfaction was rare: only one interviewee, a coach, rated the program overall as less than five. This interviewee mentioned issues with staff turnover, tenant challenges, and energy benchmarking that caused overall program dissatisfaction. These issues are discussed in additional detail elsewhere in the report.

Figure 6-5. Building Operator and Coach Overall SEiO Satisfaction



6.3.3 Building Operator Engagement

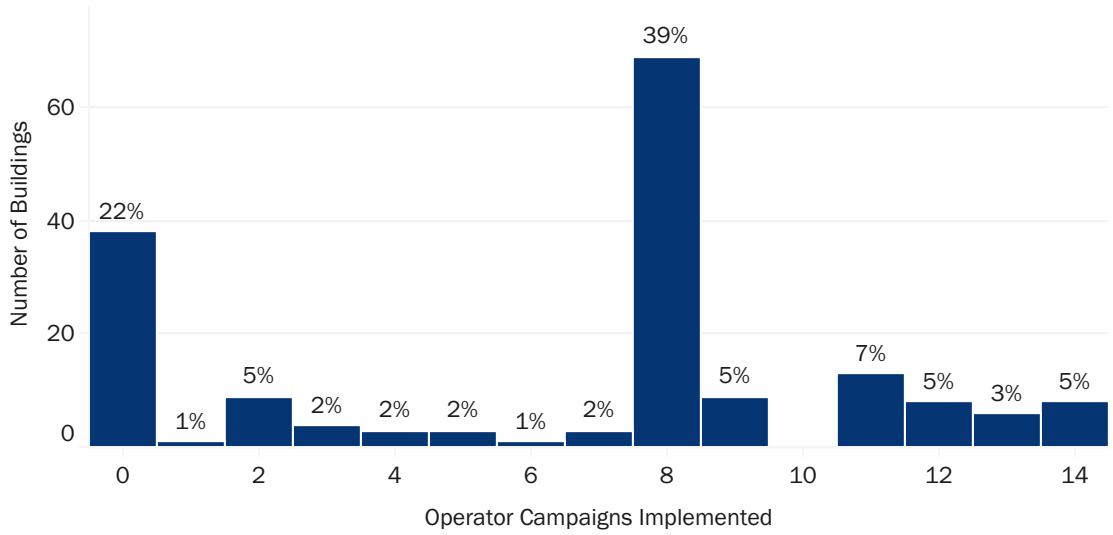
This section details findings on program interventions related specifically to building operator engagement, with a focus on operator campaigns. To understand the operator engagement, we have combined a detailed analysis of campaign participation data with feedback from operators and program staff.

Operator Campaign Implementation

This section presents analysis of building operator participation data, including implementation of building operator campaigns by building, over time, and by intervention. The following analyses include all activity between September 2014 and February 2017, regardless of whether a customer was included in the billing analysis or not.

Analysis of building operator campaign data showed that 78% of enrolled buildings had implemented at least one operator campaign within the evaluation period. However, the number of campaigns implemented at each building was not evenly distributed, as shown in Figure 6-6. It should be noted that a higher percentage of **all** building operators had completed at least one campaign by February 2017 (78%) than when only considering buildings included in the billing analysis (68%). This suggests that a higher percentage of recent enrollees (those enrolled after February 2016) have completed at least one campaign than the older enrollees included in the billing analysis. For detailed results related to only the billing analysis buildings, see Appendix B: Detailed Process Evaluation Findings.

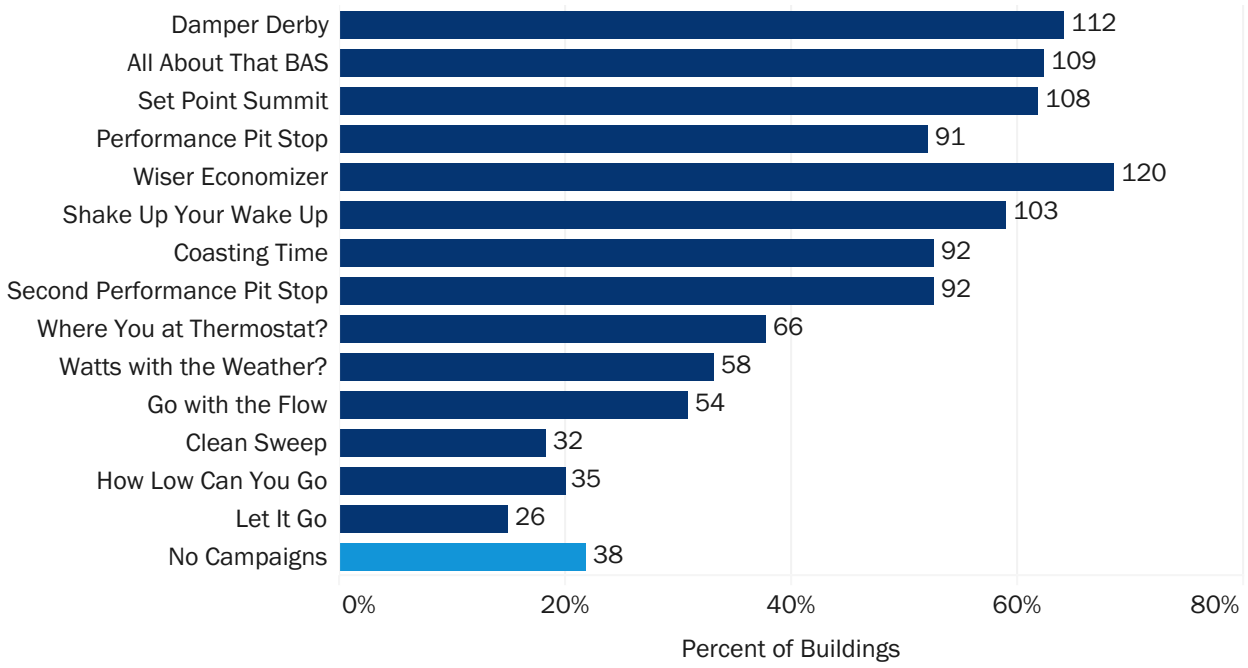
Figure 6-6. Distribution of Building Operator Campaigns Implemented



Notably, a significant plurality of buildings (39%) had implemented exactly eight campaigns. For the most part, the buildings with exactly eight campaigns participated in the first eight campaigns offered through the program. As shown in Figure 6-7, participation in building operator campaigns has, in general, been declining over time. In particular, there is a significant drop-off in participation after the first eight campaigns (Damper Derby through Second Performance Pit Stop).[31] According to program implementation staff, building operator engagement staff conducted a concerted outreach effort in March of 2016 before the building operator awards dinner; this outreach coincided with the eighth campaign, Second Performance Pit Stop.

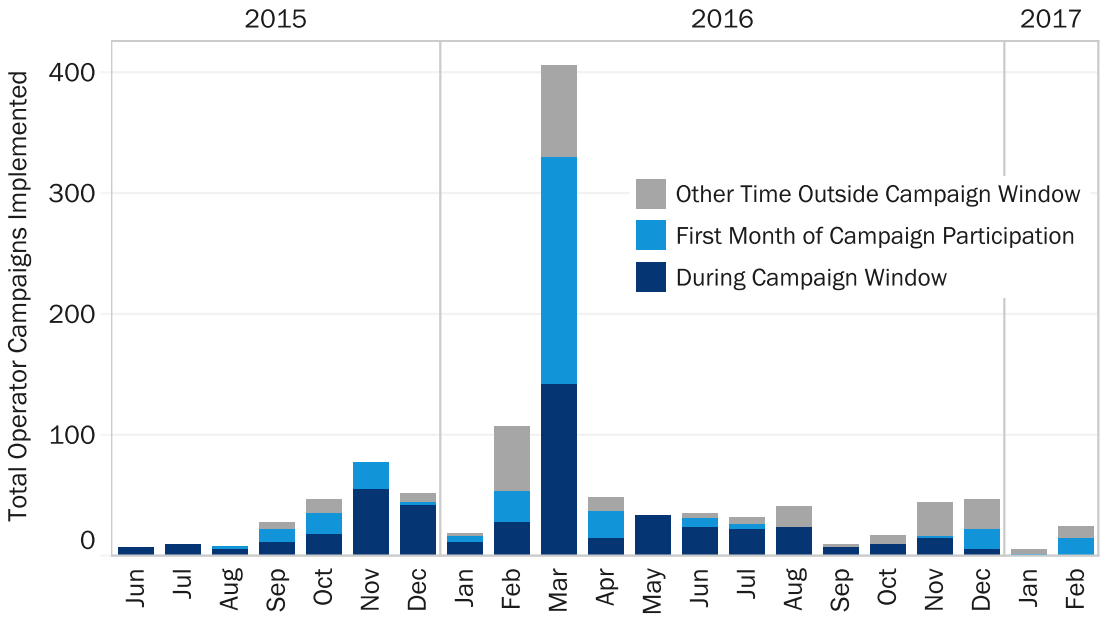
[31] Building operators could still participate in these later events.

Figure 6-7. Building Operator Campaign Participation (Chronological Order)



While operator campaigns were marketed to participants on a community-wide calendar basis, participating within this campaign window was not required. Figure 6-8 shows the total number of building operator campaigns implemented in each month. Campaigns are categorized by whether they were implemented during the campaign target window (dark blue), outside this period but within the first month an operator started implementing campaigns at all (light blue), or at another time. Over half (55%) of all building operator campaigns were implemented outside the campaign's targeted window. (In many cases, however, newly-enrolled buildings were conducting previously-launched campaigns when beginning to participate in their first campaigns.)

Figure 6-8. Total Building Operator Campaigns Implemented by Month



Notably, over one-third of campaigns (37%) were implemented in March 2016, consistent with the outreach effort before the 2016 building operator awards dinner described above. In addition, two operator campaigns were offered in March, whereas a single campaign is offered in most months. These results suggest that the outreach conducted by SEi0 staff, and possibly the opportunity to receive recognition at the awards dinner, motivated a large number of operators to implement campaigns, including many who had previously not implemented any campaigns at their buildings.[32]

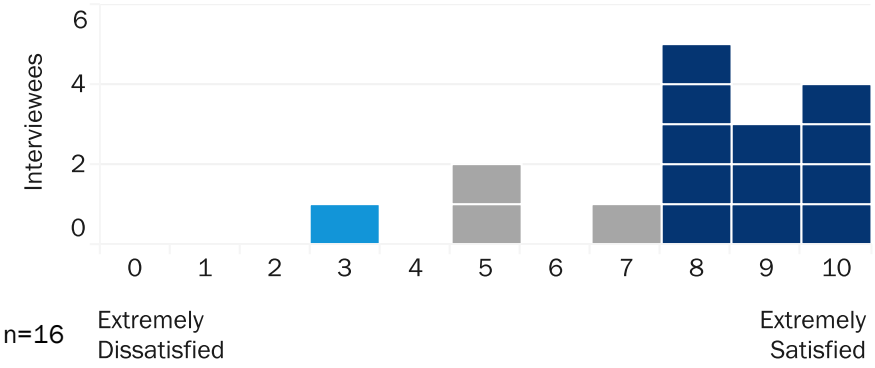
However, there were two other program developments that may explain this decrease in participation after March 2016. First, program staff changed the platform used to distribute operator campaign recruitment emails over the summer of 2016. In November of 2016, they discovered that a "vast percentage" of these messages were filtered into spam or junk filters and did not reach the intended recipients. This timeline may explain the drop-off in participation in September and October of 2016 when emails were not reaching many participants. Second, the program experienced turnover in the engagement manager staff position in April 2016 and again in September 2016. According to program staff, this turnover had a detrimental impact on maintaining momentum and engagement. Since hiring two new engagement managers in November 2016, program staff report that the trend in lower engagement has been reversing over the course of 2017.

Operator Campaign Experiences

Building operators were generally satisfied with the campaigns, with three-quarters rating their satisfaction as 8 out of 10 or higher (mean rating of 7.9 out of 10). Figure 6-9 shows the distribution of building operator campaign satisfaction ratings.

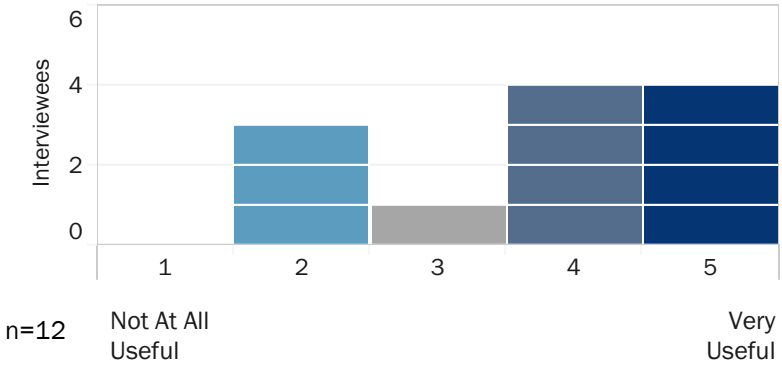
[32] While not part of the evaluation period, we did look at campaign participation in the months leading up to the second annual awards dinner, held in June 2017. While the spike in participation was not as high, there was a bump in campaign participation between March and May 2017. May 2017 had the fourth-highest number of campaigns participated since the program launched.

Figure 6-9. Satisfaction with Building Operator Campaigns



Similarly, two-thirds of operators rated the usefulness of the campaigns as four or five out of five (very useful), as shown in Figure 6-10.

Figure 6-10. Usefulness of Building Operator Campaigns



Operators frequently described their satisfaction with or the usefulness of the building operator campaigns as reminders or reinforcements of maintenance and operations activities they should already be doing, as described in Awareness and Motivations (Section 6.3.1 above). However, these sentiments translated into varying levels of satisfaction and usefulness for the operator campaigns. Consider the three statements about the building operator campaigns presented in Table 6-1.

Table 6-1. Sample Interview Excerpts and Ratings Related to Building Operator Campaigns

Interview Excerpts	Satisfaction (0–10 Scale)	Usefulness (1–5 Scale)
"I think that's a really good check. You know, those are best practices that we should be doing anyways, but I think it is a good check for our team to be reviewing all of those systems."	10	5
"The ones … that I participated in were all components of a good on-going commissioning program, which I think every building operator ought to be doing."	7	2
"I didn't find much value in it, so I would say 1 [not at all useful] … [Pause] Let me back up. I'll say a 2 simply because it was a reminder of things you should already be doing."	3	2

All three interviewees indicated that they were aware of the M&O practices promoted by SEiO. From their perspective, SEiO was not introducing new M&O practices that would save energy; rather, the program was reinforcing existing M&O practices. However, their perspectives on this aspect of the program were clearly different. The first interviewee found the "check" to be very useful, and was accordingly extremely satisfied (10/10). The second found limited usefulness from the campaigns, but was nonetheless moderately satisfied (7/10) with the "framework of [retro]commissioning," as he later described it. The final interviewee, in contrast, expressed some frustration and dissatisfaction with the campaigns (3/10) because they did not provide new information and required a significant investment of time and effort, and nearly gave a usefulness rating of "not at all useful" (1/5) before revising the rating to a two.

Operator Campaign Barriers

Operators were infrequently able to articulate discrete barriers to implementing operator campaigns. One operator interviewee did, however, report that campaigns took too much time and effort:

> *"For me, it was the data collect. I mean, anybody can go into that sheet and [put] those answers down without knowing the real answer. But if you wanted to get something out of it, you had to go do the legwork and … for me, that was what was time-consuming."*

This statement is notable because this interviewee was one of the three quoted in Table 6-1 (above), reporting that the operator campaigns were of little use (usefulness=2) "because it was a reminder of things you should already be doing." That is, this individual gave contradicting statements by implying he already takes the actions encouraged through the program but that the program required him to put additional effort into the campaigns. This view reflects participants' complicated understanding of a program that encourages improvements in practices that are presumably already part of their job responsibilities. Simply because participants do not recognize the usefulness or value of the SEiO campaigns does not imply the campaigns do not contribute to saving energy.

SEiO building operator campaigns encourage building operators to enter discrete responses into the Smart Energy HQ, requiring them to observe or measure various aspects about their buildings' use and operations. The statement that the above operator needed to spend additional time making these observations and measurements implies he may not have previously been doing all of the operator campaign activities. Furthermore, not all operators found the campaigns to be difficult or time-consuming. One operator characterized his high satisfaction with the campaigns by saying that the campaigns are "easy to work with."

More often, operators mentioned lack of engagement because the campaigns were duplicative of what they are already doing, consistent with the finding that operators see the campaigns as reminders or a

formalization of work they are "already doing." However, in some cases, this view of the campaigns was sufficient for operators to decide not to participate in additional campaigns. One operator elaborated on this perspective:

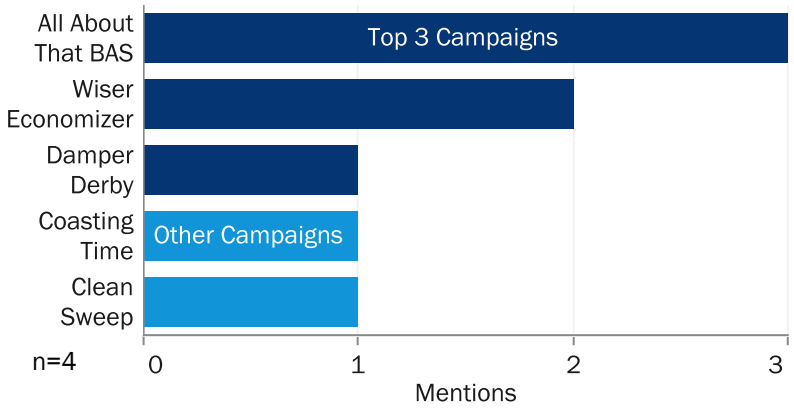
> *"I'm not really excited about any of them. I feel that a lot of the things that they're going over we've already done in our facilities. Maybe it's just because of the experience that we already have, and maybe other buildings don't have that experience."*

While not facing barriers *per se*, some operators felt the campaigns were not valuable enough to commit the time and resources to completing them.

Most and Least Useful Campaigns

The evaluation team also asked operators which campaigns, if any, they felt were most useful. While many building operators' responses reflected the sentiment that each campaign was an important part of a complete M&O plan, a few mentioned specific campaigns, which are summarized in Figure 6-11. All About That BAS and Wiser Economizer were mentioned most frequently (n=3, n=2, respectively). However, these two campaigns and Damper Derby were the three campaigns with the highest participation, representing six of the eight campaign mentions (dark blue). This finding likely reflects the higher proportion of interviewees to participate in these campaigns. Additionally, one response to this question revealed some confusion with tenant campaigns; the building operator mentioned he felt the Vampire Stakeout tenant campaign was particularly useful.

Figure 6-11. Most Useful Operator Campaigns



Similarly, the evaluation team asked operators which campaigns were the least useful. Only one interviewee identified a specific campaign as less useful than the others. This operator identified Damper Derby, explaining that his building simply did not have dampers, so the campaign was not relevant.

Overall, building operators consistently reported that the suite of SEiO building operator campaigns together make up a robust M&O platform. Because the campaigns tend to focus on different, specific aspects of a building's operations, individual campaigns were not seen as particularly useful, but the campaigns overall were at least somewhat useful. Operators also consistently reported that they were already aware of most or all of the M&O activities encouraged through the campaigns, but differed on the usefulness of and satisfaction with this framework.

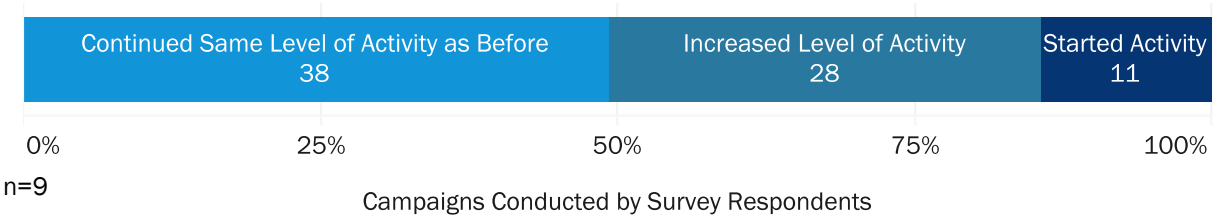
Operator Campaign Efficacy and Outcome Persistence

In addition to collecting data on free-ridership in support of the net energy savings analysis, the operator (and coach) follow-up survey gathered building operators' perspectives on the efficacy and persistence of energy savings from campaign participation. For each campaign, operators were asked if they started or increased monitoring & verification activities during the campaign (the "activity" question). For example, for the All About that BAS campaign, operators answered the question:

> *The All About that BAS campaign asked you to verify the accuracy and calibration of your building's Building Automation System and associated sensors. For this campaign, would you say that you…*
>
> *1. Started doing this type of verification for the first time*
> *2. Increased the frequency or detail of verification that you had already been doing*
> *3. Continued the same level of BAS verification as before*

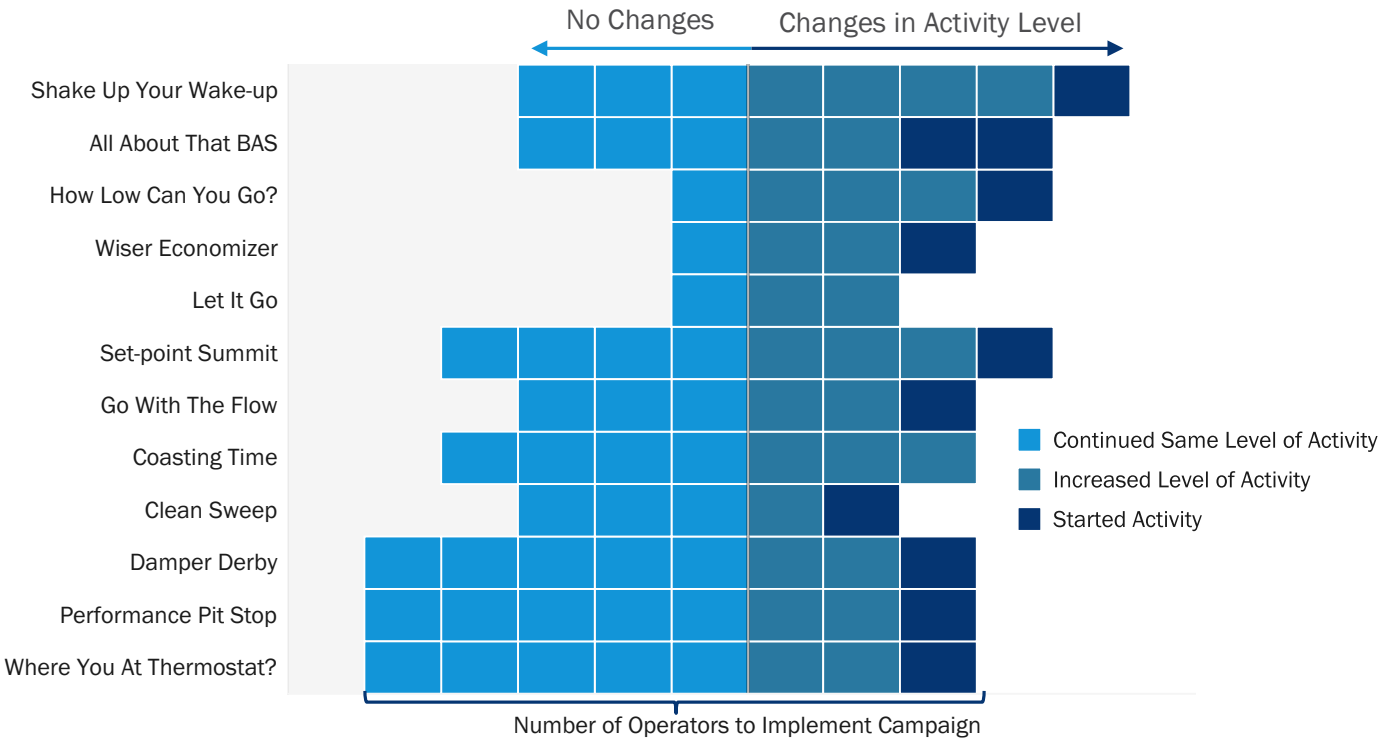
Figure 6-12 shows all responses to activity questions for each campaign that an operator participated in. Building operators reported starting or increasing the verification or other maintenance activity approximately half (51%) the time.

Figure 6-12. Changes in Monitoring & Verification Activity from All Operator Campaigns



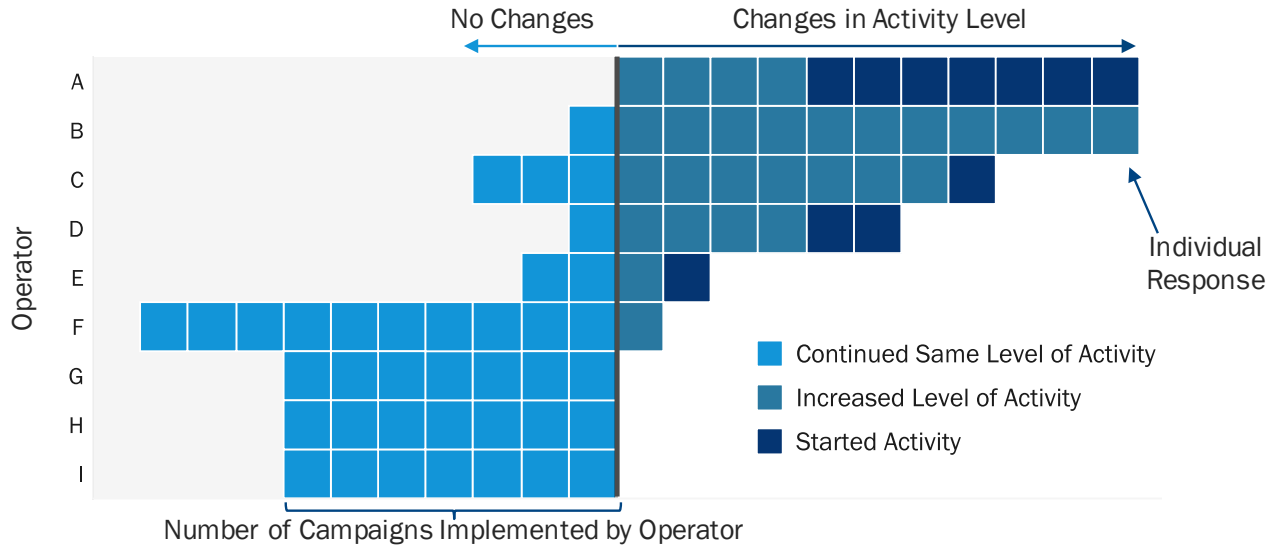
The results did not indicate that particular campaigns were more or less successful in generating new activity among operators (that is, successfully encouraging activities *that operators were not already doing*). Figure 6-13 shows all responses to the activity question for each building operator campaign. Each block in the figure represents an individual response, with responses to the right of the gray line indicated a desired outcome (in this case, starting or increasing a monitoring & verification activity). Roughly half of the operators reported a desired outcome for each campaign; more data would be required to validate the observed differences between campaigns.

Figure 6-13. Changes in Monitoring & Verification Activity by Operator Campaign



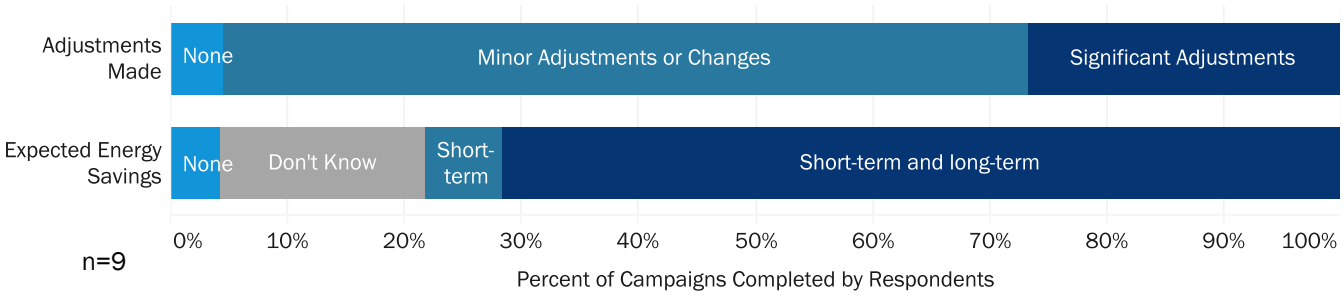
Further analysis of the data, however, revealed notable differences between building operators. Figure 6-14 shows that some operators made changes during all or most campaigns, while others made little or no changes across the campaigns they participated in. That is, differences in activities outcomes are likely driven more by the experience and program engagement level of the individual building operator than by the targeted outcomes for each campaign.

Figure 6-14. Changes in Monitoring & Verification Activity by Operator



In cases where building operators reported increases in activity, operators were asked whether they made adjustments or changes as a result of the increase in monitoring & verification effort ("adjustments made"), and whether these adjustments would lead to savings in the short- or long-term, if any ("expected energy savings"). Figure 6-15 summarizes the responses to these questions for all operators and campaigns (between campaigns, no differences in these responses were observable other than the short-term savings discussed below).

Figure 6-15. Level of Adjustments and Expected Energy Savings from Increased M&O Efforts

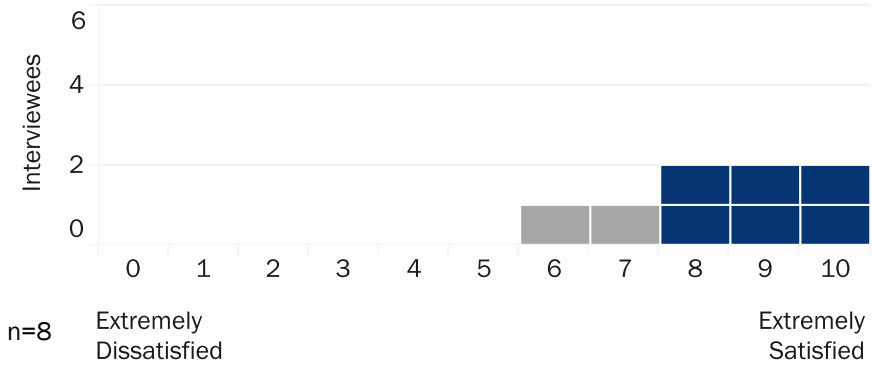


Building operators reported making changes for 95% of campaigns. While the majority of these were reported as minor adjustments, operators reported the majority of these adjustments would lead to both short- and long-term energy savings. Two of the three instances where savings were expected only in the short-term were reported for Watts with the Weather, which encourages short-term changes to interior set-points to reduce cooling loads, so these responses are consistent with the campaign's design. The only instances in which operators reported no expected energy savings were those where they reported no adjustments even after increasing monitoring & verification efforts. However, in a relatively small number of cases, two building operators reported that they were not sure whether the reported adjustments or changes would result in energy savings. While building operators began or increased monitoring and verification activities for only about half of campaigns, nearly all of these new activities resulted in adjustments from which building operators expected energy savings.

Forums and In-person Events

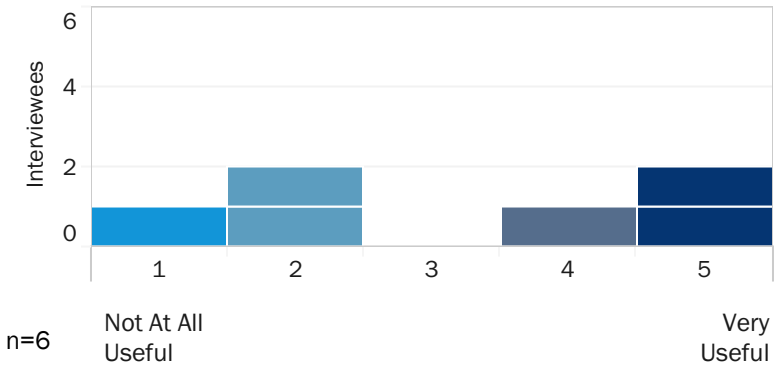
Overall, building operators were satisfied with building operator forums and other in-person events such as the annual awards dinner. Over half of building operators who attended in-person events were satisfied (≥8), and no operator rated the events as less than six, as shown in Figure 6-16. One operator explained, "The best part is we have real property operators just explaining … real cases, real situations with real numbers."

Figure 6-16. Building Operator Satisfaction with Forums and In-person Events



While building operators were generally satisfied with the forums and in-person events, not all necessarily found them useful. Figure 6-17 shows the distribution of usefulness ratings on a scale from 1 (not at all useful) to 5 (very useful).[33] Both operators who indicated mild satisfaction (6 or 7) indicated that the forums were only slightly useful, rating them as two out of five. However, one interviewee indicated that he was extremely satisfied (10), but found them not at all useful (1); this operator explained that he personally did not like these types of public events in general, but thought the forums were well-run and informative for other building operators. Overall, these findings indicate that the building operator forums and in-person events are running smoothly and many, but not all, building operators find them valuable.

Figure 6-17. Building Operator Usefulness of Forum & In-person Events



[33] All interviewees who attended in-person events rated their satisfaction, but some interviewees were not asked to rate the usefulness of the events to reduce response burden.

Operational Assessments

At the data was collected for this evaluation, four buildings had received energy audits, known as operational assessments, from a team of University of North Carolina at Charlotte (UNCC) students and professors. Operators for two of these buildings were interviewed for the evaluation. Both reported that they had not yet received the audit report; in one case the assessment was completed over a year before the interview. The one who had been waiting over a year rated the usefulness of a program as "not at all useful" (1/5) on these grounds, while the other declined to rate it. Consistent between these interviewees was that both had yet to receive any useful information regarding the results of the operational assessments at the time of the interview.

In the time since data was collected for this evaluation, Duke Energy has continued to expand their collaboration with UNCC and the role of these operational assessments. According to program staff, the operational assessments are one of the program offerings that have been improved the most since the evaluation period ended. The program has now completed dozens of assessments and have implemented formal processes to ensure assessment reports are timely. According to program staff, the assessments are "extremely successful and a highlight of the program" and providing "significant savings opportunities, [including] actions that were not previously pursued."

6.3.4 Tenant Engagement

This section details findings on program interventions related specifically to tenant engagement. To understand tenant engagement, we have combined a detailed analysis of campaign participation data with feedback from coaches and program staff. Because of the very low response rate to the tenant survey, we have not included results from this effort.

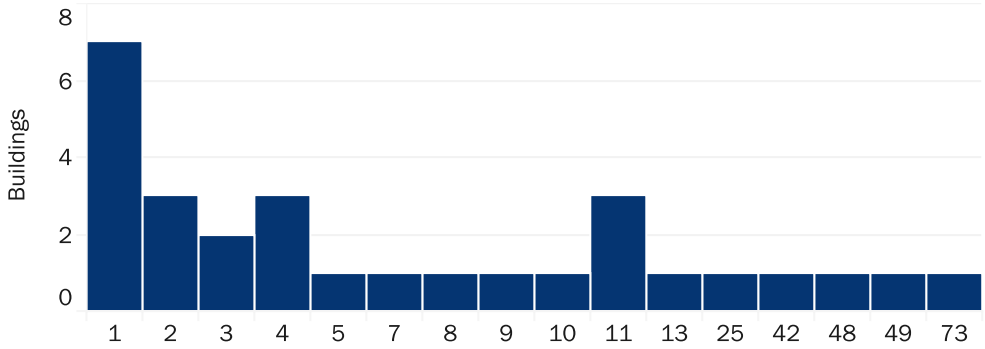
Tenant Challenge Implementation

The following presents analysis of tenant challenge participation data. Topics include participation in building tenant challenges by building, over time, and by intervention. These analyses include data from Add It Up, Butterfly Effect, Fall Off, and Winter Warm Up, the challenges implemented within the evaluation period (before the end of February 2017).

In April 2016, the program offered the first community-wide tenant campaign, Add It Up. This campaign was centered on getting customers to register in the Smart Energy HQ, complete workplace energy use profiles, and read insights about how they could help their building save energy. This campaign had relatively high participation, with 1,050 tenants from 76 buildings registering and creating profiles in the Smart Energy HQ. After this campaign, the program shifted to the newer tenant challenge model, which focused on logging commitments to save energy in the Happen App or MyEnergyChallenge.com.

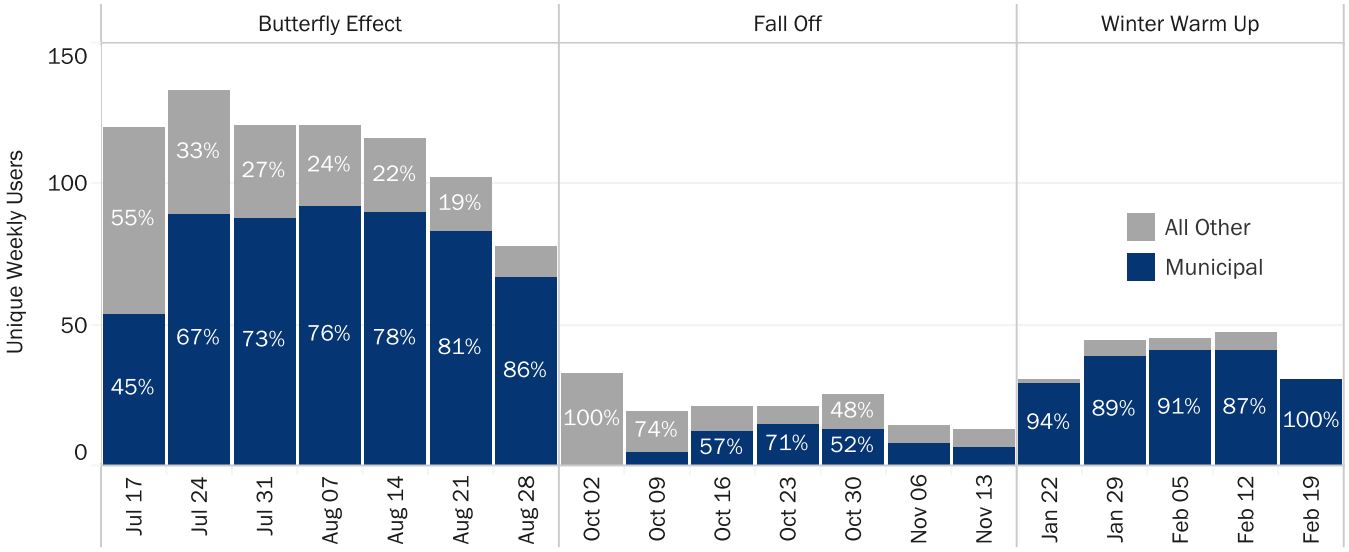
After the Add It Up campaign, a minority of buildings (14%) went on to participate in the newer-style online tenant challenges. Among the 29 buildings that had participated in at least one tenant challenge, however, tenants' engagement was limited; 12 buildings had 3 or fewer tenants create online user log-ins for the Happen App or MyEnergyChallenge.com, as shown in Figure 6-18. In contrast, only 7 buildings had 10 or more tenants create user log-ins. While more tenants could be reading challenge collateral and implementing featured actions, but not tracking these actions online, logging activity through the Happen App or MyEnergyChallenge.com is the primary ask made of tenants.

Figure 6-18. Distribution of Unique Online Tenant Challenge Users per Building



Analysis of tenant challenge participation data revealed a number of notable patterns. Figure 6-19 shows the total number of unique users to participate in each week of the first three community-wide tenant challenges, differentiating between users from municipal organizations and users from other organizations.[34]

Figure 6-19. Unique Weekly Users by Campaign and Organization



Campaign participation was dominated by users from two municipal organizations in nearly every week of the three campaigns. Over two-thirds (69%) of users are registered under municipal government buildings, and users at these buildings accounted for an outsized share (75%) of all actions taken, indicating that these users are also more active than users from other organizations. While the more active of the two organizations decided not to participate in Fall Off, the other organization still accounted for the majority of unique users in five out of the seven weeks. The coach from the organization that did not participate in Fall

[34] Appendix B: Detailed Process Evaluation Findings includes these results for only customers included in the billing analysis, to show how participation relates to savings being measured.

Off reported that they made an active decision not to participate in this challenge (this finding will be discussed in additional detail in below).

Engagement in non-municipal buildings was also concentrated at two organizations within a single commercial real estate (CRE) building. This building's users accounted for more than half of non-municipal unique weekly users in every week of Butterfly Effect and Fall Off. Participation within this organization, however, decreased over time from 38 unique users in Butterfly Effect, to 20 in Fall Off, to only 2 in Winter Warm Up.

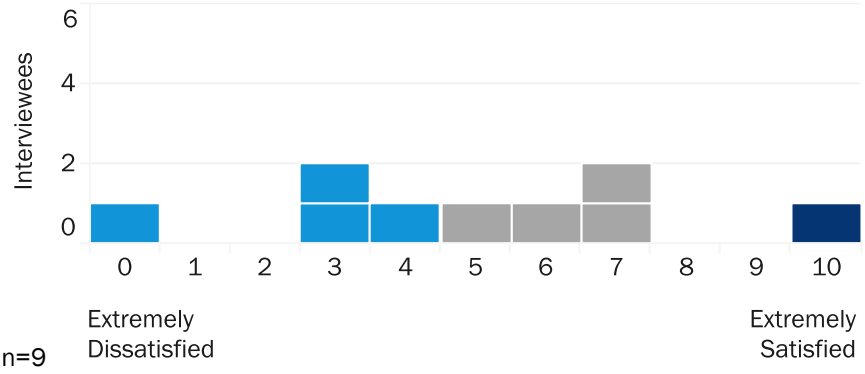
Overall, tenant participation has tended to decrease over time, both within and across challenges. While Winter Warm Up saw greater participation than Fall Off, this increase was driven by the most active participant deciding to participate again. Nonetheless, participation in Winter Warm Up was less than half that of Butterfly Effect. The trend in participation is particularly notable within non-municipal organizations, where participation has decreased since the kickoff of Butterfly Effect, when nearly 50 users pledged to take challenge actions. Across organizations and campaigns, participation begins to taper after the fourth or fifth week of participation.

While tenant challenges are intended to engage building occupants through MyEnergyChallenge.com and the Happen App, actions logged through these media do not fully reflect tenant engagement in the challenges. The limited data collected through the tenant survey suggest some tenants "participate" in the challenges without logging commitments: two of the four respondents who reported taking targeted energy-saving actions never recorded those actions, and the other two did so less than half the time.

Tenant Challenge Experiences

Interviews revealed that many coaches are not engaged with tenant-focused challenges. Satisfaction with the challenges was, on average, neutral (5/10), as shown in Figure 6-20. SEiO coaches reported a range of difficulties with successfully implementing tenant challenges that led to relatively low satisfaction.

Figure 6-20. Coach Satisfaction with Tenant Challenges



The majority of responses fell between mild dissatisfaction and mild satisfaction (3–7), indicating that overall satisfaction with tenant challenges was driven by an overall lack of engagement with these challenges. Discussion with coaches revealed that, in most cases, they engaged with the tenant platform to a limited degree.

In particular, coaches were often not aware of the extent to which tenants were participating in the challenges. One coach reported that he organized an SEiO kickoff event in his multi-tenant commercial real

estate (CRE) building, including a raffle for an Amazon tablet for those who signed up for the program. However, his involvement diminished after that: "I know we signed up several tenants and then we encouraged the tenants to participate, but we didn't do anything building-wide after the initial setup." Consistent with this statement, he was also not entirely clear on the difference between the earlier tenant "campaigns" and the current tenant "challenges," saying he thought "they did the 'Crab, You're It!' type stuff, but … I do not think anybody used the app." Tenant challenge data also showed only a single user participating in a single week of Butterfly Effect in his building. While this coach rated his satisfaction as a seven out of ten, his responses indicate that he was actually not familiar with tenant challenges. Similarly, another coach did not recognize the two most recent campaigns by name. He reported, "We had the buildings participate in the Butterfly Effect campaign. I believe that was last spring or summer 2016 … but the other two, they sound familiar but I'm not sure exactly which of those we participated in."

Finally, another coach, who was responsible for three multi-tenant CRE buildings, reported that she was not sure how active her buildings' tenants were in the challenges. She estimated that two tenant organizations within these three buildings would likely have been interested in participating; tenant challenge participation data revealed that only a single organization participated in the challenges. This coach, however, correctly identified the participating organization, noting that this organization was likely motivated to engage with the program because of the organization's corporate sustainability goals. She explained, "They have a whole department that's … dedicated to sustainability. We have to send to them on a monthly basis … our water usage and our electricity usage. I think it depends on what type of tenants you have."

Program staff told the evaluation team that they had already identified a need to "expand tenant captain engagement in order to ensure that campaign communications are widely distributed." These findings underscore this need by highlighting that even coaches, customer program champions at the highest level, are themselves in many cases unengaged.

Engaged Coach Perspectives

The coach of the buildings with the highest tenant participation was the most engaged of those contacted. Notably, this interviewee was the only interviewed coach who worked for the occupant organization, as opposed to a third-party property manager or a building owner in a multi-tenant CRE building.

She mentioned many actions she takes to promote the challenges and encourage participation that are not required, such as customizing emails to foster competition between the various teams within the organization. In addition to personalizing the emails to make them more relevant to her organization, she explained:

> *"I encourage them to participate. I try to get a little bit of healthy competition between [teams]. When I send out my emails every week, I say, 'Oh, [Team 1] is really stepping it up, and they've surpassed [Team 2]. So, hey, [Team 2], let's show [Team 1] up.' And then I'll send that same week to [Team 1], like, 'Hey, we surpassed [Team 2]. Let's keep it up. Don't let them keep up with us.'"*

Adding this type of messaging requires data—for example, which team or group within an organization had the most participation in the previous week. She mentioned that, for the original tenant campaigns, this data had been easily accessible through the Smart Energy HQ. In contrast, this data was harder to access for the newer tenant challenges, as she explained:

> *"I pull up the app on my phone, and I manually count how many people are participating and how many actions they've taken or how many points they have, and then I have to*

distinguish whether they're [Team 1] or [Team 2] people based on the building that they're in."

Feedback on Campaign and Challenge Formats

Where possible, the evaluation team collected feedback on differences in experiences between the previous tenant campaigns and the current tenant challenges. However, only two interviewed coaches were familiar enough with both tenant engagement models to provide feedback. One said that overall, the new app- and web-based strategy is more effective because the challenges require less of a time commitment:

"They evaluated their program over the years and fixed things that weren't working and you can tell that things are working better. It's more web-based now … and … that works a lot better especially with everyone being … busy trying to do their day-to-day job being able to just log in … rather than having to physically participate in something, I think is a lot better."

The other generally agreed with this perspective, but also added that in-person engagement is necessary to generate momentum and participation in the program. She explained:

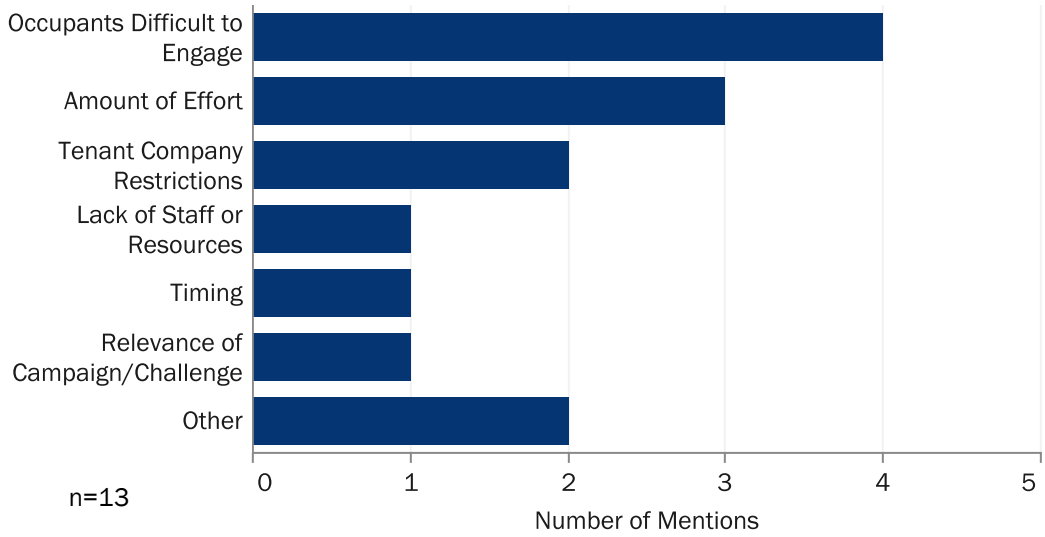
"I think a blend is probably ideal. Maybe … having the rep available or coming out to generate a little bit of a buzz. But for the most part, … from an efficiency perspective, people are used to getting online and looking and things. But I do think that the in-person aspect is important periodically."

SEiO implements in-person "lobby events" that are consistent with this feedback, suggesting these are an important part to generating continued participation in tenant challenges.

Barriers to Tenant Engagement

Coaches reported a variety of barriers to participating in building tenant challenges. Notably, while the evaluation team contacted more building operators than coaches, coaches were more often able to articulate discrete barriers to participation in the tenant challenges. The barriers reported by these interviewees are summarized in Figure 6-21.

Figure 6-21. Coaches' Barriers to Participating in SEiO Tenant Challenges



Coaches most frequently mentioned challenges engaging occupants specific to their buildings' tenants or company type. For example, one reported the occupant organization was too large to engage, while another said the various occupants in the building were too small to engage. The first, a third-party property manager, described internal challenges with the company that occupies the building, saying, "They're just a big corporation with a lot of moving parts. I feel like an SEiO program is a lot easier to manage for a smaller, private company or it's easier to get the message from top down." In contrast, another said his tenants were difficult to engage because, "We don't have any tenants that have really large teams … The biggest tenant we have is probably 15–20 employees. So it's not any huge full-floor groups … like we might have in an uptown building."

Another coach described the tenant-owner incentive split as a barrier from engaging with tenant challenges. She reported: "The landlord pays the utility bills, so the tenants don't really realize the savings … because they don't open a bill each month. If it was … where the tenants [paid] their own utilities, I could see where they might be a little more enthusiastic." That is, tenant organization leadership had no incentive to encourage their employees to conserve energy.

Finally, one coach mentioned that the building is mostly occupied by mortgage and other residential real estate-related organizations, which in her opinion were simply less interested in energy conservation programs like SEiO. These results may suggest that certain sizes or types of organizations are ideal to engage, but may also simply reflect that the buildings' leadership teams were not sufficiently engaged and organized to encourage significant participation. Furthermore, none of these coaches were representatives of the tenant organization or organizations, so they may have less influence over building tenants.

Interviewees also frequently cited the amount of effort required to participate as a barrier to engaging in the tenant challenges. Specifically, coaches reported that requiring tenants to access the site daily in order to fully participate was too burdensome:

> *"The challenges that we have found … in engaging our tenants is they were … required to log in every day and … pledge or make a commitment and check the site every day, which I did not really think was realistic."*

Program staff reported that coaches have already given similar feedback regarding the time and effort required to participate. Accordingly, challenges going forward will be adjusted to request tenants "to make a one-time pledge to participate in challenges and take actions when they can, as opposed to their being asked to log in and record actions daily."

Two coaches also mentioned restrictions on tenant internet access because the organization handled sensitive data, such as personal or financial data on customers. One of these coaches explained:

> *"Most of my tenants out here are high security tenants, so they don't allow their employees access the Internet. … [Program staff] did come up with something for them to [fill in] by hand. But the tenants really didn't want their employees sitting around [filling them out]. So it was not well-received. Actually, several of my tenants told me not to bother them with the campaigns anymore."*

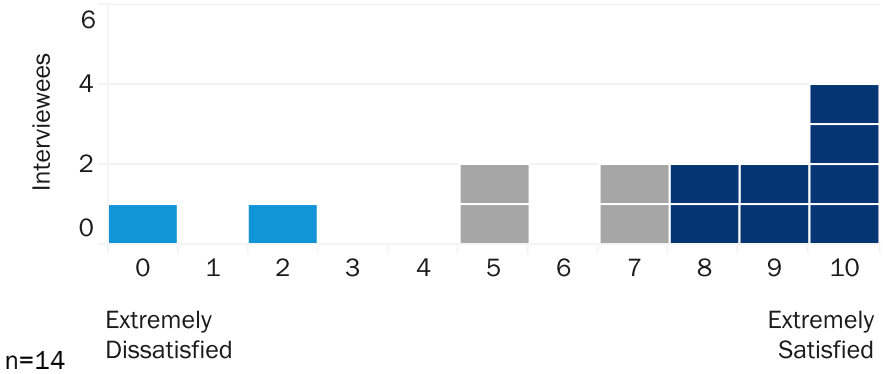
Other barriers reported for tenant challenges and operator campaigns included lack of staff or resources to implement the interventions, timing related to the sale of a building, and the relevance of the intervention.

The barriers described above help explain why it was so difficult to complete surveys with tenants at participating buildings. Our first approach of including a link to the tenant survey in a program email was dependent on coaches distributing program emails to their captains and/or tenants, and then tenants reading the email and taking the survey. While it is impossible to know which of these did not happen, the lack of responses to the tenant survey likely reflect the overall lack of engagement with tenant challenges. This may have been exacerbated by the technical issues the program experienced when emails to coaches and tenants were caught by spam filters. With our second approach, the survey link was embedded on the MyEnergyChallenge.com landing page during an active challenge. However, because customers who have their log-in information saved would skip this page, it is impossible to know how many tenants would have seen the link in the first place.

6.3.5 Building Energy Benchmarking

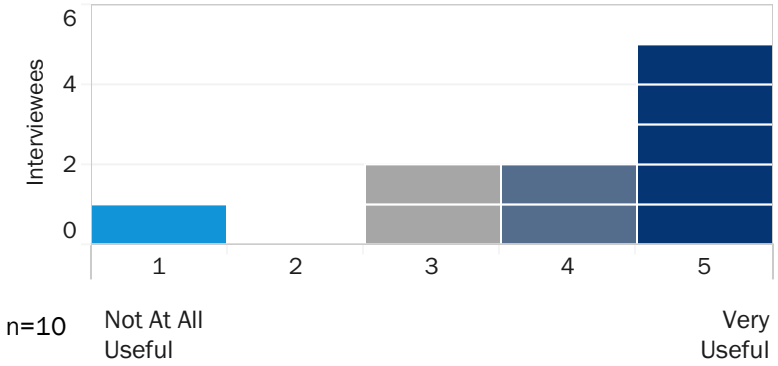
Overall, 45% of participating buildings took advantage of the automated ENERY STAR benchmarking services provided by the program during the evaluation period. Most interviewed operators and coaches were satisfied with the building energy benchmarking services and support provided through SEiO and felt these services were useful. Over half (57%) indicated satisfaction with benchmarking (≥8/10) and the mode was 10 ("extremely satisfied"), as shown in Figure 6-22.

Figure 6-22. Operator and Coach Satisfaction with Building Energy Benchmarking



Similarly, half of interviewees rated benchmarking as "very useful" (5/5), and only one interviewee rated the usefulness of benchmarking services and support as less than three out of five, as shown in Figure 6-23.

Figure 6-23. Operator and Coach Usefulness of Building Benchmarking Services and Support



Consistent with the recognition motivation discussed previously, building operators often attributed high satisfaction and usefulness ratings to gaining recognition for their efforts, saying, for example, "[My organization wants] to be able to showcase what us engineers can do." In addition, one building operator related benchmarking his buildings to being able to make the business case for energy-saving capital upgrades. He reported:

> *"What I would do is use the benchmarks to see whether or not the building was performing. And then say, 'Okay, to keep the building's performing at this level, we had to spend X dollars in maintenance.' Using that, then go back to the [client] and say, 'Look. You've got to invest capital. Because here's where you're losing your money.'"*

However, two interviewees expressed dissatisfaction with benchmarking, both due to limitations in the benchmarking services provided. In one example, the interviewee's organization wanted to benchmark energy costs along with energy consumption, but the automated benchmarking service through SEiO only includes electricity consumption. She explained, "It doesn't put in dollars, so we have to go back and put all the dollars in." That is, though the electricity benchmarking process was automated, energy cost benchmarking still required manual entry, so automation did not save the organization much time overall. She continued, "Plus, it doesn't put in natural gas, so we still have to go put in all the natural gas." (This interviewee also rated the usefulness of automated benchmarking services as "not at all useful".) While other fuel types are beyond the scope of SEiO, this participant wanted a complete benchmarking profile of the building, including all fuel types and energy costs.

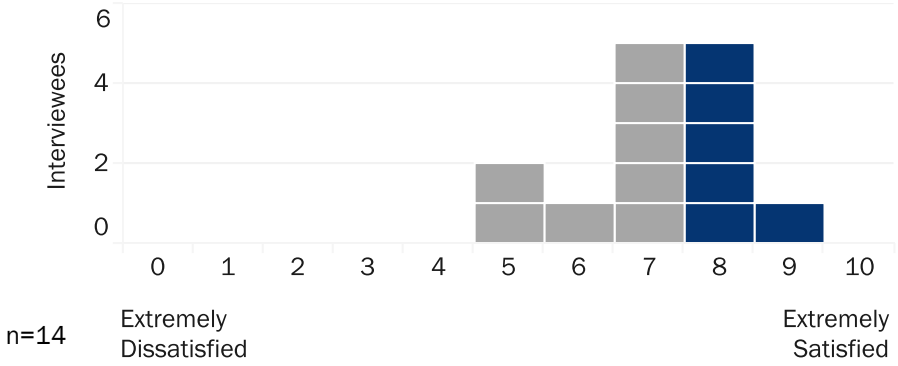
The second interviewee initially enrolled in SEiO primarily to benchmark her organization's building portfolio. However, she reported that not all of the organization's buildings were eligible for SEiO, so only these buildings were able to enroll in automated benchmarking, which caused confusion for the people who were responsible for managing the portfolio. In the end, this interviewee was unable to take advantage of the one service she had hoped to receive from participating in SEiO. She explained:

> *"We turned it off because we had people who were updating Portfolio Manager for all of the other buildings, … not just the [buildings] that are participating in this program. And then the Smart Energy people would go in and add theirs in, and it was either overriding or double-counting … It just got really confusing. So, it was easier for us to say, 'Look, if we're going to update 90, we might as well update 100 of them.'"*

6.3.6 Smart Energy HQ

Interviewed operators and coaches were generally fairly satisfied with the Smart Energy Headquarters (HQ), with all satisfaction ratings between five and nine, as shown in Figure 6-24. One interviewee, who indicated neutral satisfaction (5/10), explained, "I just go in and answer the questions, so it wasn't anything that was memorable."

Figure 6-24. Operator and Coach Satisfaction with Smart Energy HQ



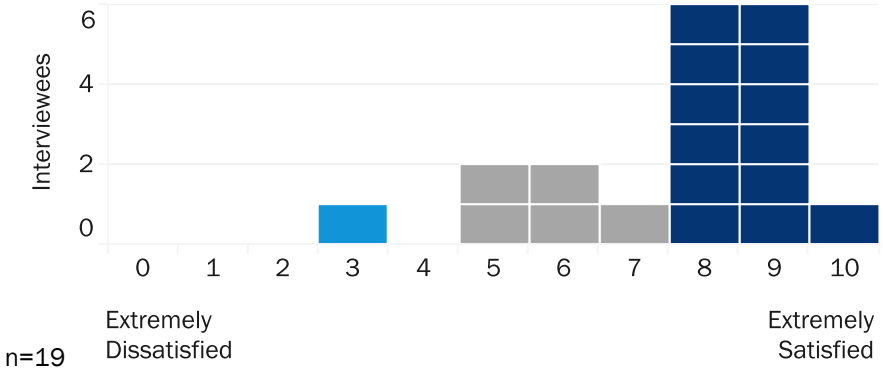
Building operators reported a few minor issues with the tool. One reported that he was waiting on the HQ to provide his building's hourly energy consumption data, saying, "I'll put down an 8. I'm still waiting for them to update my real-time data and my monthly." Another said, "They had a few bugs, but they got it worked out pretty [well], so I thought it was a pretty good tool."

Later in the interview, when asked about how SEiO could help save more energy through the program, one operator revealed that he may not be aware of all of the Smart Energy HQ functionalities. He replied, "I don't know if they could give us … a graph on how much we actually use," apparently not realizing this information is available in the HQ.

6.3.7 SEiO Program Staff and Representatives

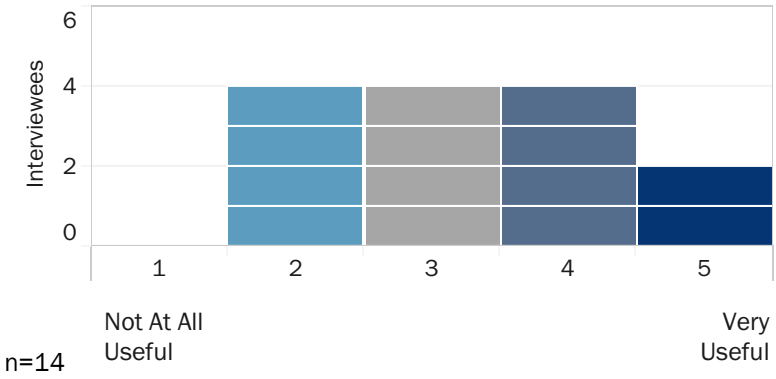
Overall, building operators and coaches were fairly satisfied with their interactions with SEiO program staff and representatives. Over two-thirds (68%) of interviewees were satisfied (≥8/10) with their interactions with program staff and only one was dissatisfied (≤4/10), as shown in Figure 6-25.

Figure 6-25. Operator and Coach Satisfaction with SEiO Program Staff & Representatives



Interviewees frequently mentioned positive interactions with SEiO program staff. As one operator and coach reported, "The engagement on Duke's side is great. They're there when you need them. They'll meet with you at any time to try to help make the program successful." All interviewees also found SEiO program staff at least somewhat useful, as shown in Figure 6-26.

Figure 6-26. Operator and Coach Usefulness of SEiO Program Staff & Representatives



Despite the positive interactions participants had with individual program representatives, seven interviewees—over one-third—mentioned issues relating to staff turnover. In many cases, interviewees reported that staff turnover directly contributed to their rating of dissatisfaction or low usefulness. Consider the following statements about satisfaction with and usefulness of program staff related to turnover presented in Table 6-2.

Table 6-2. Sample Interview Excerpts and Ratings Related to Program Staff Turnover

Interview Excerpts	Satisfaction (0-10 Scale)	Usefulness (1-5 Scale)
"[My satisfaction] would be 10, but I'm going to have to go with 9 since they've been swapping out people, so once you start getting some good flow, you keep introducing me to another person."	9	5
"I would give it a [usefulness of] 5, but [my contact] went away. I don't even know who the guy is anymore. When [my contact] was here, it was good. He contacted me probably every couple weeks."	9	4
"The gentleman is new, so he's still learning about the program. There was a gentleman who I met when I first started who was very well-versed, but he has moved on."	6	2
"All the people I have interacted with have been extremely nice and professional … and easy to work with. … I really would like to make the point that the reason [my satisfaction is] so low is more … to do with the turnover."	5	Not Asked
"I've never even met these new people … The original staff, I was satisfied with them … 7 or 8 maybe, on the scale. Then they left … and then there are these new people I don't know yet."	3	Declined

In the five excerpts above, interviewees either spoke highly of individual SEiO representatives, or at least did not indicate any problems with them. In these cases, however, interviewees specifically indicated that despite positive interactions with individual staff, they were rating the satisfaction with or usefulness of SEiO program staff lower *because of* the turnover in staff.

Overall, these results suggest that while individual program staff themselves are highly competent and professional, staff turnover can create gaps in the customer experience in which customers are not in contact with program staff for a period of time, and customers may have to spend additional time and resources bringing new staff up to date on building and participation history.

7. Conclusions and Recommendations

This section presents conclusions and recommendations resulting from the impact and impact evaluation of the Smart Energy in Offices program.

7.1 Conclusions

This evaluation measured the gross and net savings achieved by the 199 accounts that enrolled in Duke Energy's SEiO program between September 2014 and February 2016. While each of these accounts enrolled in a three-year participation period, this evaluation was designed to estimate savings achieved as of February 2017. This means that we estimated savings over varying participation periods depending on when customers enrolled, from 30 months of participation for the earliest enrollees to 12 months for the most recent ones. Because many of the participants may go on to engage in more program campaigns after our February 2017 cut-off, this evaluation provides a very specific measure of the program's impacts: savings through February 2017 from accounts that enrolled between program inception and February 2016. To the extent that program offerings have changed or participants have engaged more deeply since February 2017, our average annual savings estimates may not reflect the savings participants realize over their entire three-year enrollment period. This is important to consider when interpreting the results in this evaluation since (1) the effects of the program are expected to continue to accrue over the three-year participation period that participants commit to when they enroll and, more importantly, (2) the program has continued to improve the offerings available to enrollees since its launch in fall 2014. If changes make the program more effective, if program engagement increases over time (as outreach staff work with participants), or if savings from program interventions persist and accumulate over time, then the estimates from this evaluation under-estimate program savings. Indeed, the program has made a number of changes that are not captured in the results from this evaluation, such as engaging University of North Carolina Charlotte students to complete building audits and help customize operator campaigns for each participant. While we cannot be sure that savings are under-estimated, it will be important to evaluate this program in the future to determine full savings from a mature version of the program (incorporating early changes to program design) with participants who have completed their three-year participation period.

This evaluation estimated gross savings separately for customers that were and were not part of the precursor Smart Energy Now (SEN) pilot program because of two key differences between these groups. First, SEN participants started engaging with Duke Energy earlier, during the SEN pilot, and have continued this engagement through SEiO. Second, for the most part, SEN participants are also participants in the public private collaborative in Charlotte, Envision Charlotte.[35] While Envision Charlotte does not directly target energy savings, there are synergies between SEiO and Envision Charlotte, with staff from both efforts cross-promoting each other's programs. Because of these differences, it may not be possible to extrapolate the experience of Envision Charlotte participants to the larger population of SEiO participants.[36]

[35] Envision Charlotte is a public-private program implemented in Charlotte that promotes sustainability more broadly, including areas like water and waste efficiency. As part of their partnership with Duke Energy, Envision Charlotte does not focus on energy efficiency but rather leaves energy savings interventions to the SEiO program. Duke Energy did not have a complete list of Envision Charlotte participants, so SEN participation was the best available proxy for Envision Charlotte participation.

[36] While not related to program implementation, another difference was that SEN buildings also had higher and more stable occupancy rates than non-SEN buildings.

The gross annual savings from the program are summarized in Table 1-1. While SEN participants save an average of 5.0% annually through SEiO, we were not able to detect statistically significant savings for non-SEN participants after accounting for savings that Duke Energy has claimed through other energy efficiency programs.[37] Savings are higher amongst customers who have reported engaging with the SEiO's building operator campaigns, but the high number of buildings that have not reported implementing campaigns does limit the ability to detect savings amongst those customers who are using the program's services (because they are still considered participants, we have included these buildings that have not reported campaign activity in our billing analysis, which introduces more noise as we try to isolate savings from billing data). It should also be noted that all groups of customers save energy overall before we deduct savings that have been claimed through other energy efficiency programs offered by Duke Energy. To the extent that SEiO is helping motivate participants to pursue savings through Duke Energy's rebate programs, our estimates under-estimate the effect of the program.

[37] Our ability to detect a trend between tenure and savings for non-SEN pilot buildings is limited by the fact that non-SEN buildings in general have participated for a shorter period of time than have SEN pilot buildings. It is possible that as time goes on, the relationship between tenure and savings for non-SEN pilot buildings may become meaningful.

Using self-report data from building operators and coaches, we estimated a free-ridership rate of 9.5%. This resulted in a net-to-gross ratio of 0.905 that we applied to all buildings that achieved measurable savings through the program to estimate net impacts. Table 7-1 shows savings by stratum, while Table 7-2 shows savings by building size.

Table 7-1. Summary of Annual Gross Savings by Stratum

Stratum			N[a]	Average Annual Change in Energy Consumption Before Adjusting for Other EE Savings (%)[b]	Average Annual Change in Consumption After Adjusting for Other EE Savings (%)[b]	Average Annual Change in Consumption After Adjusting for Other EE Savings (%)[b] Annual Change in Consumption After Adjusting for Other EE Savings [b]		Net Annual Change in Consumption After Adjusting for Other EE Savings and Free-ridership [c]	
						%	kWH	%	kWH
Non-SEN Pilot Participants	Large	Engaged (#1)	44	-1.3%	-0.6%	-0.3% (90% Prediction Interval: -1.7% to +1.4%)	-1,039,628	0.0%	-22
		Non-reporting (#2)	13	-3.0%	+1.6%				
	Small	Engaged (#3)	59	-2.1%	-0.4%				
		Non-reporting (#4)	33	-8.0%	-5.4%				
SEN Pilot Participants	Large & Small	Engaged (#5)	19	-6.4%	-5.2%	-5.0% (90% Prediction Interval: -8.1% to -1.5%)	-14,684,033	-4.4%	-13,007,235 [a]
		Non-reporting (#6)	10	-6.0%	-4.6%				

a. The number of buildings shown here includes those buildings that were excluded from the analysis because they did not have at least 12 months of pre-enrollment period data.
b. Negative values indicate savings.
c. Net-to-gross ratio of 0.905 was applied only to sites with measurable savings through the program. If a building's consumption increased, we did not apply a net-to-gross adjustment.

Table 7-2. Summary of Annual Gross Savings by Building Size

Size Group	Billing Analysis N	N[a]	Average Annual Change in Energy Consumption Before Adjusting for Other EE Savings (%)[b]	Average Annual Change in Consumption After Adjusting for Other EE Savings [b]		Net Annual Change in Consumption After Adjusting for Other EE Savings and Free-ridership [c]	
				%	kWH	%	kWH
Large (>=100,000 s.f.)	72	80	-4.5%	-2.6%	-13,990,486	-2.2%	-11,767,407
Small (< 100,000 s.f.)	91	98	-3.6%	-1.9%	-1,733,174	-1.4%	-1,239,850

a. The number of buildings shown here includes those buildings that were excluded from the analysis because they did not have at least 12 months of pre-enrollment period data.
b. Negative values indicate savings.
c. Net-to-gross ratio of 0.905 was applied only to sites with measurable savings through the program. If a building's consumption increased, we did not apply a net-to-gross adjustment.

Our process evaluation sought to explore building operators' and coaches' experience with the program, as well as to better understand trends in terms of participants' engagement with the various services the program offers. Overall, our process evaluation found the following:

- Building owners and coaches are motivated to participate by bill savings and the tools and information that the program provides for implementing efficient maintenance and operations practices. Marketing services and the recognition provided by the program are also important motivators.
- Building operators and coaches are satisfied with program tools, staff, and activities.
  - Satisfaction was highest with the forums and events for building operators and coaches (8.4 on a 0 to 10 scale), although only about half of interviewed operators and coaches had attended these.
  - Overall, satisfaction was also high with the building operator campaigns (7.9), program staff (7.6), program overall (7.3), automated building benchmarking (7.1), and the Smart Energy HQ (7.1).
  - Building operators' and coaches' satisfaction was lowest with energy savings (6.1) and tenant challenges (5.0).
- There is variability in how active participants are in engaging with program campaigns and services.
  - Just over half of building operators had completed eight or more campaigns, while almost one-fifth of operators had not recorded implementing any campaign actions in the Smart Energy HQ by February 2017.
  - Building operator campaign participation increased substantially after program staff conducted a concerted outreach effort in March of 2016, in advance of the first building operator awards dinner. Building operators earned awards based on their level of campaign activity at this dinner, which may have motivated them to complete multiple campaigns in the month leading up to this event. However, there was a large drop-off in operator campaign participation after the March 2016 building operator awards dinner. While this drop-off may have reflected the role of the awards dinner in motivating building operators, changes in engagement staff personnel and communication modes may have also played a role.
- There is variability in how useful building operators found building operator campaigns.
  - Two-thirds of operators rated the usefulness of the campaigns as four or five out of five (very useful).
  - Many operators characterized the information they received through the building operator campaigns as reminders or reinforcements of maintenance and operations activities they should already be doing.
  - When asked how campaigns affected their practices, building operators reported starting or increasing verification or performing other maintenance activities during half of completed campaigns, while not making any changes for the other half of campaigns. How much campaigns influenced operators' behaviors varied more across operators than across campaigns.

  - Overall, the less engaged building operators were not able to articulate specific barriers to implementing operator campaigns, but some mentioned that campaigns were duplicative of what they were already doing or not valuable enough to commit the time and resources needed to complete them.

- Recognition and awards appear to be powerful motivators for building operators.
  - There was a very large spike in campaign participation before the first awards dinner that recognized building operators and coaches for their participation.
  - Building operators and coaches ranked the recognition they received through the program as very useful, with over half of interviewed respondents ranking it as "very useful."
- The tenant challenge approach is a harder sell for many businesses and requires an active coach to advocate and organize challenges.
  - After the first tenant challenge aimed at getting tenants to sign up for the program, a minority of buildings (14%) went on to participate in at least one of the online tenant challenges.
  - Among the 29 buildings that had participated in at least one tenant challenge, tenant engagement was limited: twelve buildings had three or fewer tenants create online user log-ins for SEiO's online tools – the Happen App or MyEnergyChallenge.com.[38]
  - Many coaches were relatively unengaged with tenant challenges and often not aware of the extent to which tenants were participating in the challenges. The largest barriers reported to participating in tenant challenges included difficulty engaging tenants and the amount of effort required.
  - The most engaged coach that was interviewed reported taking many actions not required by the program to promote the challenges and encourage participation, such as customizing emails to foster competition between the various teams within the organization.
- While overall satisfaction with program staff was high, over one-third of interviewed building operators and coaches mentioned issues related to implementation program staff turnover without being prompted. Building operators' comments suggest that staff turnover can create gaps in the customer experience in which customers are not in contact with program staff for a period of time, or may have to spend additional time and resources bringing new staff up to date on building and participation history.

[38] The Happen App and MyEnergyChallenge were developed by Accelerated Innovations. While Envision Charlotte was a catalyst for the development of the Happen App, and the app was used to help facilitate Envision Charlotte's non-energy challenges in 2016, Duke Energy, and not Envision Charlotte, helped fund the app.

7.2 Recommendations

Through the process and impact research, we identified several opportunities for program improvement.

Consider implementing more stringent requirements for what constitutes participation in SEiO.

The SEiO program has minimal requirements for what a customer must do to sign up for the program and be considered a participant. While this may help Duke Energy enroll a larger number of customers—and increase the chances of engaging them further—it also poses a risk for program savings. Overall, enrolled customers who have not reported implementing campaign actions have saved less energy. Including customers as participants when they are not actively participating (and presumably not saving energy) introduces noise that compromises the ability to measure energy savings amongst active participants. Moreover, because consumption increased on average for customers who had not implemented campaigns, including them as participants reduced overall program savings.

The program may be able to increase program savings by requiring more frequent engagement than simply completing one campaign in three years. Alternatively, if Duke Energy prefers to keep program requirements minimal to help get a foot in the door with difficult-to-engage customers, the program could differentiate between what is required of a participant to enroll in the program and what is required before Duke Energy claims savings for the customer. Currently these are defined by the same action: enrolling in the program, regardless of whether the customer has completed any campaigns. However, 63 of the 199 enrolled accounts included in our billing analysis had not reported completing any campaigns at the time of our evaluation. By creating a more stringent definition of "participation" and only claiming savings for those accounts that have interacted with the program beyond enrolling (for example, campaign participation or building benchmarking), Duke Energy could still enroll as many customers as possible and work to engage them in the program as part of the customer acquisition process, while minimizing the risk to realized program savings.[39]

In addition to requirements around campaign participation, Duke Energy should consider more stringent requirements around the contact information required at enrollment. We found that contact information for coaches and building operators was missing or outdated for a number of buildings, which limits the ability of program staff to engage these stakeholders (as well as our ability to collect data on the barriers to participation). Since building operators and coaches are key to driving savings through the program, not having these individuals identified is likely to reduce the program's effectiveness. Requiring current contact information from an operator or coach before they enroll would reduce the potential for buildings that are not saving energy, and it would ensure that program staff have the ability to engage all buildings.

Reconsider Targeting Strategy to Focus More on Customers with Higher Potential for Savings

The program currently uses a strategy for targeting potential participants that starts with more efficient buildings, such as ENERGY STAR Certified Buildings, under the theory that "these buildings represent property management and/or tenant organizations that place value on building energy performance, and would be likely to embrace a program that could provide new means to drive further energy efficiency

[39] Because the program is a unique mix of interventions for each participant, our evaluation depends on measuring changes in consumption after enrolling in the program. If consumption increases for a participant, which is more likely for non-engaged customers, this has the result of lowering average and total program savings.

improvements."[40] However, the results from this evaluation indicate that customers with less efficient buildings (higher EUIs and lower Energy Star scores) have a higher likelihood of saving energy. While customers with more efficient buildings may be easier to engage and more likely to participate because of their interest in saving energy, the results from our interviews suggest that these customers may already be implementing many or most best practices in building operations. Thus, there may be a trade-off between targeting more efficient buildings to achieve higher participation rates versus less efficient buildings that may achieve greater per-participant savings. It may be that program resources are more effectively used in targeting and engaging customers that have high EUIs and low Energy Star scores, even if these customers are harder to engage in the program.

Consider Increasing Focus on the Quality Rather than Quantity of Actions Promoted Through Campaigns

Building operator campaigns currently reward points for *answering* questions related to operator campaigns, regardless of whether or not there was any change in operator behavior or improvement in building energy efficiency. For example, a building operator receives the same number of points for answering yes or no to a question about whether they had made changes to equipment set-points. The information collected on the number of campaigns and number of building operator points does not help provide insight into the *quality* of actions that building operators are taking, and it does not show whether there are any behavioral changes taking place. This makes it hard for program staff to understand how effective these campaigns are in changing operations and maintenance practices. Having more nuanced data related to the quality of actions would help the program to understand how effective various campaigns have been and where there are opportunities to further target activities and customer engagement. In addition, shifting to performance-based awards instead of, or in addition to, activity-based awards may help better align building operators' motivations with program goals. To this end, the evaluation team understands that since the data was collected for this evaluation, Duke Energy has already started to develop a more customized approach to building operator campaigns in which participants will select and be rewarded for recording implementation of applicable building re-tuning measures.

Consider Additional Strategies to Encourage Building Operators to Meaningfully Engage in Campaigns and Other Interventions throughout the Year

Campaign tracking data revealed that over one-third of campaign actions were recorded in March 2016, shortly before the building operator awards dinner. Implementing many campaigns within a single month may dilute the impact of each campaign and result in less engagement throughout the rest of the year. Operators could be encouraged to engage consistently with bonus points for campaigns that are completed within the targeted window; both campaign participation data and operator interviews indicate that recognition is a powerful motivator for building operators. Alternately, campaigns could be open only during the targeted window and require staff approval to conduct a campaign at another time (for example, when a building enrolls in SEiO), setting a norm of implementing campaigns on the community-wide schedule.

Additionally, Duke Energy may want to consider more frequent timing for recognizing building operators and coaches. If awards were bestowed quarterly or bi-annually, that may help keep building operators and coaches engaged throughout the year, rather than just before the awards dinner. Moreover, Duke Energy could align the timing of awards with participation requirements or targets to help reinforce enhanced

[40] Smart Energy in Offices Plan Program Description and Theory Document.

requirements or targets. For example, some form of quarterly award or recognition could reinforce a target for each operator to complete at least one campaign per quarter.

Consider Additional Strategies to Engage Coaches, Captains, and Tenants to Increase Tenant Challenge Participation

Program participation and interviews with coaches revealed that, with a few notable exceptions, tenant challenge participation and coach engagement were low overall. Coaches that were most successful in engaging tenants actively promoted the program within their organizations, for example adding organization-specific content to the weekly SEiO email newsletters and encouraging competition between challenge teams. SEiO program staff should engage coaches and, to the extent possible, team captains on an ongoing basis to help them, in turn, to engage tenants. In particular, SEiO program staff should be in direct contact with a representative of each tenant/occupant organization, such as a captain in a multi-tenant building. Reaching captains may be particularly important in commercial real estate buildings, where building owners may enroll in the program, but not have a direct connection with the tenants of that building. In the case of commercial real estate buildings, it will be less likely that coaches are part of the tenants' organization, and thus coaches may have less ability to influence participation in tenant challenges. While participating organizations have generally resisted contacting tenant team members directly, they may be more amenable to contacting team captains, who have volunteered to engage in the program. The evaluation team understands that since the time data was collected for this evaluation, Duke Energy has decided to increase engagement with captains. At the time of writing this report, Duke Energy was planning an email campaign to enroll more captains as well as focus groups with captains to better understand their motivations.

Consider Making Low-Cost, Low-Touch Components of the Program More Broadly Available to Participating Organizations

One coach reported that not all of the organization's buildings were eligible for SEiO, and consequently could not take advantage of automated building benchmarking for these buildings. In the end, the organization decided to continue to manually benchmark the entire portfolio, rather than benchmarking some automatically and some manually. If it is low cost to the program, allowing all buildings within a portfolio to connect to automated benchmarking would reduce the barriers and confusion related to automating a portion of the buildings. Similarly, implementation staff reported that one organization exited the program because not all buildings were eligible for the program, but the organization's policy did not allow for a subset of buildings to participate, specifically in the building operator campaigns. In this case, allowing these other buildings to access the Smart Energy HQ and campaigns may have allowed the *eligible* buildings to participate. If software services, benchmarking, operator campaigns, and tenant challenges could be expanded to participating organizations' ineligible buildings with minimal additional cost, this may lead to spillover in those buildings.

Provide a Visual Dashboard of Participation in Tenant Challenges

Coaches reported that SEiO provided little feedback on tenant challenge participation other than the campaign leaderboard, but that this type of feedback was available for the previous version of the tenant campaigns that used the Smart Energy HQ. In addition to giving direct feedback to tenants that might motivate individual participation in the challenges, such a dashboard could provide content used to customize messaging to an organization's teams, as requested by one coach. The dashboard could provide data on participation in the challenges at different levels—such as organization, team, and individual—that would allow users to find the relevant data for their organization or team.

Conduct Future Research into the Influence SEiO Has on Participation in Other Energy Efficiency Programs Offered by Duke Energy

One question that this evaluation did not answer is what influence the SEiO program is having on participants' decisions to complete capital improvements through Duke Energy's other energy efficiency programs. This is an important question, as we found that all six SEiO customer groups had saved energy before deducting savings from other programs, but not after this adjustment had been made. If some or all of the savings from other energy efficiency programs are attributable to SEiO, this could have a significant effect on the program's cost-effectiveness.

This question can be addressed through future evaluations by asking participants about the role and influence of SEiO on their decision to implement capital improvements through Duke Energy's energy efficiency programs. However, Duke Energy may also want to collect data to track this internally, to help mitigate recall bias as well as the challenges of contacting decision makers after the fact. For example, Duke Energy could add codes such as "Through SEiO Program" or "Through participation in another Duke Energy Program" to the program tracking data collected on how customers hear about the Non-Residential Prescriptive and Custom programs. Collecting this for all participants in program tracking databases would provide a quicker and fuller picture of SEiO's influence than could be collected through a sample of building operators and coaches during the next evaluation.

8. Summary Form

Duke Energy Carolinas Smart Energy in Offices Program

Completed EMV Fact Sheet

The Duke Energy Carolinas Smart Energy in Offices Program promotes electricity conservation in mid- to large-sized office buildings through a holistic approach using multiple behavioral interventions, including (1) engaging building operators with trainings and campaigns related to energy efficient building operations and maintenance, (2) engaging tenants through community-wide challenges related to energy efficiency within office spaces, and (3) providing building operators and other building stakeholders with detailed data on their energy consumption and automated building energy benchmarking.

Date	August 25, 2017
Region(s)	Duke Energy Carolinas
Evaluation Period	September 17, 2014 – February 28, 2017
Total Annual kWh Savings	13,007,257 kWh (net ex post)
Coincident kW Impact	1,393 kW (summer net ex post); 1,466 kW (winter net ex post)
Measure Life	Not evaluated
Net-to-Gross Ratio	90.5% amongst customers with gross energy savings
Process Evaluation	Yes
Previous Evaluation(s)	Smart Energy Now Pilot Evaluation. February 1, 2014.

The evaluation team performed a gross and net impact using a multi-step process.

To estimate gross energy savings, we developed site-specific time series analyses of monthly billing data at the building level for each participant. After controlling for weather, changes in building occupancy, and pre-existing trends, we estimated the change in consumption for each participant after enrolling in the program. We then adjusted these estimated savings to deduct savings claimed through other Duke Energy energy efficiency programs.

The net impact evaluation relied on participant building operator and coach surveys in order to quantify free-ridership. We did not quantify spillover, as any spillover savings within a participating building would be captured through our billing analysis. We estimated overall net-to-gross ratios for the program based on participants who had measurable gross energy savings through the program. These net-to-gross ratios were multiplied by the ex post gross savings for customers with gross savings to determine net program impacts.

9. DSMore Table

The embedded Excel spreadsheet below contains measure-level inputs for Duke Energy Analytics. Per-measure savings values in the spreadsheet are based on the gross and net impact analysis reported above. Measure life estimates have not been updated as part of this evaluation since it was not part of the evaluation scope.

SEiO DSMore Table 12.18.17.xlsx

Appendix A. Detailed Methodology

Sampling Methodology

To ensure that our building operator and coach sample was representative of the participant population, we identified three key variables with which to stratify our sample. These stratification variables were chosen to capture the range of interactions participants have had with the program, as well characteristics most likely to affect program savings. The three stratification variables are defined below.

- **Envision Charlotte Participant:** Participants that had also enrolled in the Envision Charlotte initiative were grouped separately from those that had not. We decided to segment by Envision Charlotte participation because the program treatment varied between the two groups for two reasons. First, there are synergies between SEiO and Envision Charlotte, with staff from both efforts cross-promoting each other's programs. Envision Charlotte and SEiO also share an engagement app, the Happen App, intended to make it streamlined for customers to engage with both offerings. Second, most Envision Charlotte participants were also participants in the Smart Energy Now (SEN) pilot precursor to SEiO, meaning they had been exposed to the behavioral intervention for longer than other participants. Because of these differences, the evaluation team determined it was not possible to extrapolate the experience of Envision Charlotte participating SEiO participants to the larger population of SEiO participants.

  Program staff did not have a complete list of Envision Charlotte participants. Because most Envision Charlotte participants were also participants in the Smart Energy Now (SEN) pilot, we used SEN participation as a proxy for Envision Charlotte participation.

- **Participant Engagement:** As customers choose their own level of participation in the program, engagement was expected to be a key factor driving energy savings. In theory, participants that were not engaged would see little savings, while engaged customers would experience greater savings. By assigning accounts to engagement-based strata, we were able to reduce the inherent variability of expected savings within each stratum and thus develop a more efficient (i.e., smaller), cost-effective sample. In practice, this meant our sample was split into "engaged" and "non-reporting" participants. Participants that are "engaged" are defined as having participated in at least one tenant and/or operator campaign. Participants are classified as "non-reporting" if they have not entered any campaign activity into the Smart Energy HQ. These non-reporting customers may have been truly unengaged, not participating in any campaigns, or may have implemented campaign-targeted actions without recording this information in the Smart Energy HQ.

- **Participant Size:** The SEiO program ex ante savings are tied to building size, with large customers' ex ante savings being a higher percentage of pre-program consumption than smaller customers' percentage of their own consumption. These ex ante savings were derived from the SEN pilot program evaluation, which was segmented by building size. For consistency with the way savings are claimed, we continued to stratify our sample into small and large customers using the same definition as the SEN pilot evaluation. Participants that are "large" have a reported square footage of over 100,000 square feet. We oversampled participants from the "large" stratum. By oversampling large customers, we were able to include a higher portion of total savings in our sample, which was expected to result in a lower overall error.

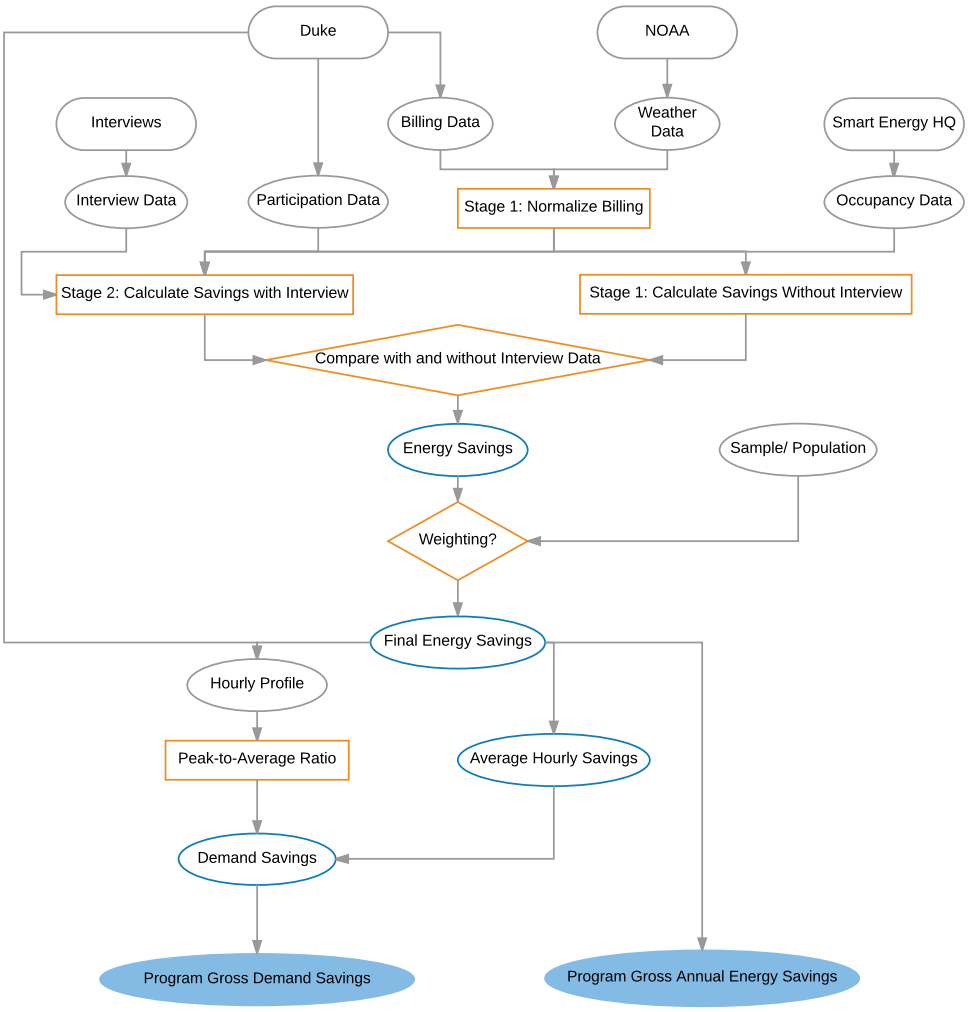
Gross Impact Methodology

In the following sections we first provide a high level overview of the billing analysis and then provide more detail on several aspects of the billing analysis related to our definition of program participation, the choice to use the full dataset versus a more restricted interview dataset, and details regarding the regression modeling approach.

Analysis Framework

The overall sequence of this analysis, including the sources for each type of data, is shown below in Figure A-1. There were three main sources of data: (1) billing data and participation data from Duke Energy, (2) weather data from NOAA, and (3) participation and occupancy data from Smart Energy HQ. We additionally collected primary data through interviews with building operators (discussed in the Process chapter of this report). All of these data sources were integrated to arrive at final estimates for gross energy and gross demand savings.

Figure A- 1. Analysis Flow Chart

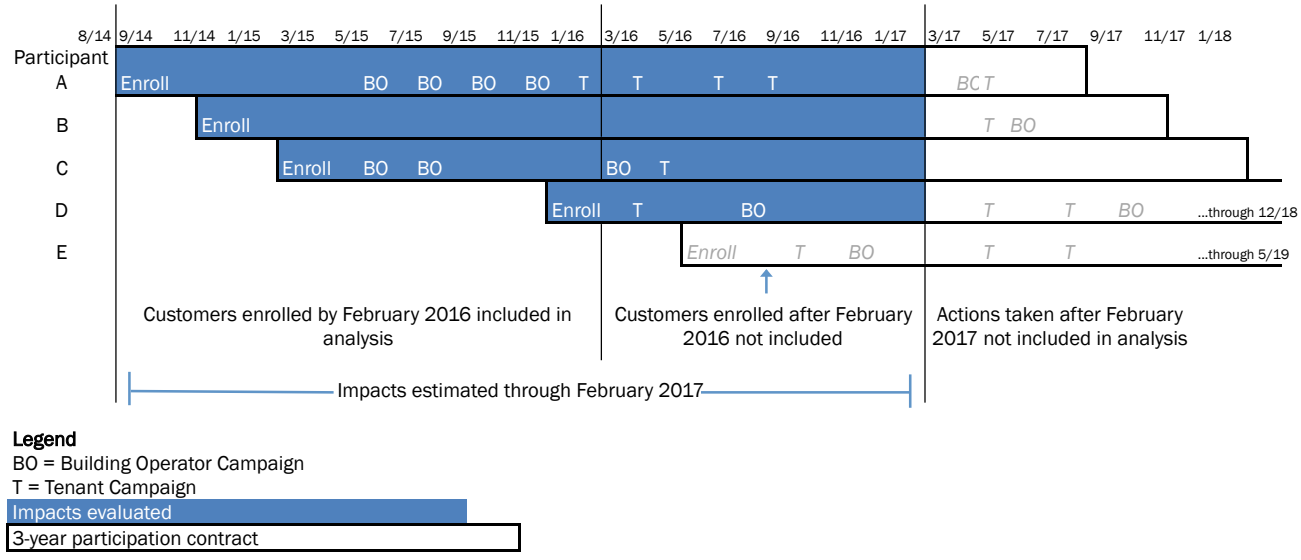


In the following sections we discuss several critical decisions made during the analysis relating to (1) the definition of program participation, (2) regression model specifics, and (3) the evaluation team's choice to use the full dataset instead of the more restricted interview dataset.

Definition of Participants

As discussed in the body of this report, for this evaluation, we defined participants as accounts[41] that have enrolled in the program, even if they had not completed any campaigns or program activities. This was the only definition that could consistently be applied to all accounts, and also ensured that we captured savings from non-observable impacts from the program, like having access to building energy use data through the Smart Energy HQ portal. This evaluation included accounts that enrolled in the program between September 2014 and February 2016. By including accounts that enrolled during this time period, we were able to include at least 12 months of post-enrollment billing data in our analysis for all participants and still meet reporting timeline requirements. Twelve months of post-participation data is standard for measuring behavioral impacts and allowed us to differentiate between seasonal patterns and program impacts. For these participants, we estimated savings from their enrollment date through February 2017. Thus the gross evaluation results provide a very specific measure of the program's impacts: savings through February 2017 from accounts that enrolled between program inception and February 2016. To the extent that program offerings change or participants engage more deeply after February 2017, our gross savings estimates may not reflect the savings participants realize over their entire three-year enrollment period. Figure A-2 illustrates a hypothetical scenario of four participants, including which ones would be included in our analysis and which months would be captured in our impact evaluation.

Figure A- 2. Hypothetical Illustration of Evaluation Period



[41] While we originally envisioned the unit of analysis for this evaluation to be the account, upon review of the data the evaluation team determined it was more appropriate to use the building as the unit of analysis, as discussed in more detail in the body of this report.

Regression Model Specification Details

As discussed in the body of this report, we employed a five-parameter change point model to develop weather variables in our building-specific regression analysis. This model is well suited for modeling individual buildings' response to weather, and allows for more flexibility than a model with fewer parameters. The five-parameter model allows for each building to have different temperature change points for heating and cooling.[42] Because we computed the parameters for our building-specific models using pre-enrollment period data only, there were several buildings for which we were unable to determine significant weather dependence due to a small number of observations. However, upon visual inspection, we noted that these buildings did exhibit some type of temperature dependence. To correct for this, we applied a single uniform change point of 65 degrees for those buildings for which we had been unable to estimate a cooling parameter from the five-parameter model. The evaluation team determined this correction was not necessary for those buildings without a heating parameter.

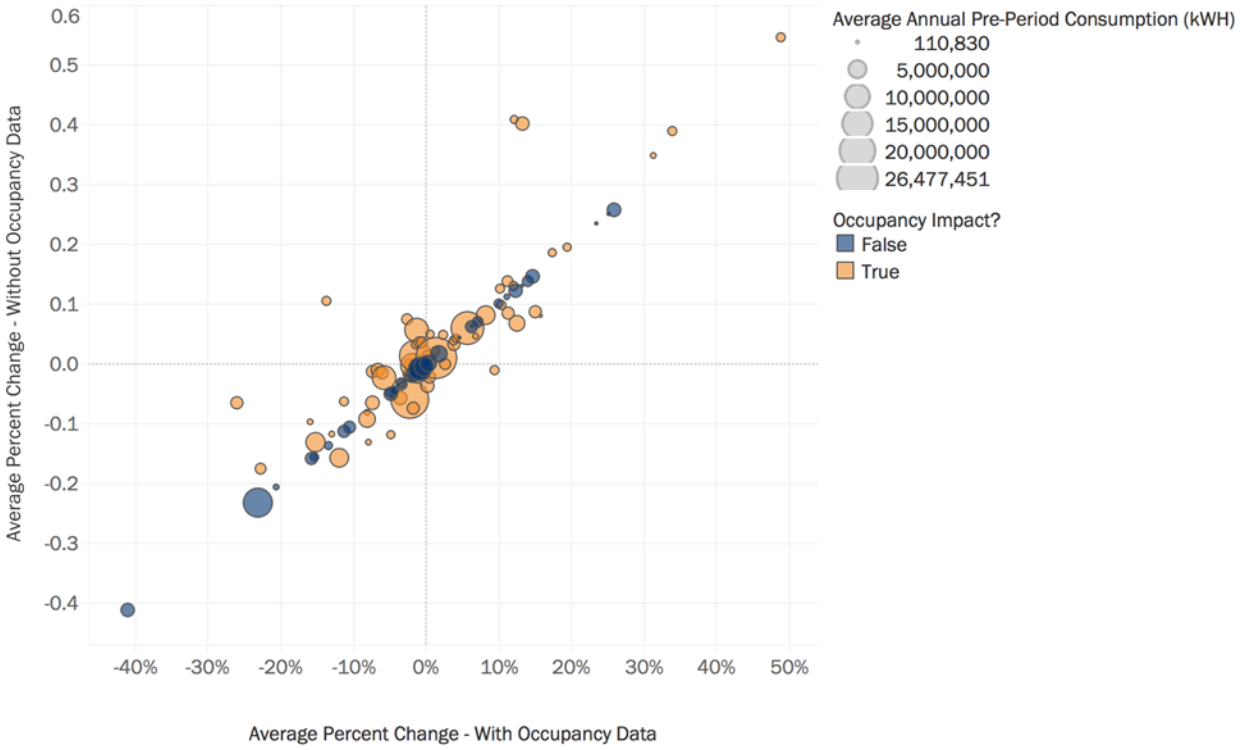
Model fit varied from building to building. The mean adjusted R-squared value (a measure of model fit) was 0.70; the median adjusted R-squared value was 0.74. Importantly, there was virtually no relationship between adjusted R-squared and estimated savings (correlation coefficient of 0.01), suggesting that results were not systematically biased in either direction by the error around the estimate. A sensitivity analysis confirmed that the effect of this relationship did not have a meaningful impact on the final modeled results.

The Effect of Incomplete Occupancy Data

A number of buildings did not have occupancy data for some or all of the period being examined. As occupancy can be an important driver of usage and therefore savings, we conducted a sensitivity analysis to understand the potential impact of including buildings without occupancy data. The effect of occupancy (on those buildings for which it was available) can be seen in Figure A- 3 below, which graphs percent change in consumption with occupancy data vs. without occupancy for this subset of buildings (n=147). Overall, the impact on program savings is not large. We estimate that not including occupancy data for these buildings would have changed the final results by less than one half of one percent. More importantly, the decision to include all buildings (even those without complete occupancy data) represented a choice to ensure that results were slightly conservative, rather than relying on a smaller subset of buildings (with occupancy data) to produce results that might be unrepresentative of the population.

[42] This model is described in more detail in: Bonneville Power Administration. 2012. "Regression for M&V: Reference Guide." https://www.bpa.gov/ee/policy/imanual/documents/july documents/3_bpa_mv_regression_reference_guide_may2012_final.pdf.

Figure A- 3. Comparison of Change in Annual Consumption With and Without Controlling for Occupancy Data, Where Occupancy Data Were Available



Identification and Removal of Outliers

The evaluation team examined monthly billing (consumption) data for outlying observations and used two methods to flag them for removal. The first method was purely deterministic: any observation outside three standard deviations from the mean monthly consumption for that building was automatically considered an outlier. This method resulted in the removal of 28 monthly observations (out of more than 8,500 observations).

Additionally, the evaluation team conducted a comprehensive visual examination of all monthly observations and flagged values at the very beginning or end of the billing data available for a customer that appeared to be inaccurate. These appeared to be artificially high values caused by short billing periods at the beginning or end of when billing data was extracted. A total of eight values were manually flagged and removed using this approach.

Identification and Removal of Buildings with Insufficient Pre-Period Data

There were a total of 12 buildings with less than 12 full months of pre-period billing data. These buildings were removed from the main analysis in order to prevent them from skewing results (since their models would not necessarily be calibrated with at least one heating season, cooling season, and shoulder season). In the final estimation of gross savings, we accounted for savings from these excluded buildings by imputing the mean percent savings value for each excluded building from that building's assigned stratum. We then

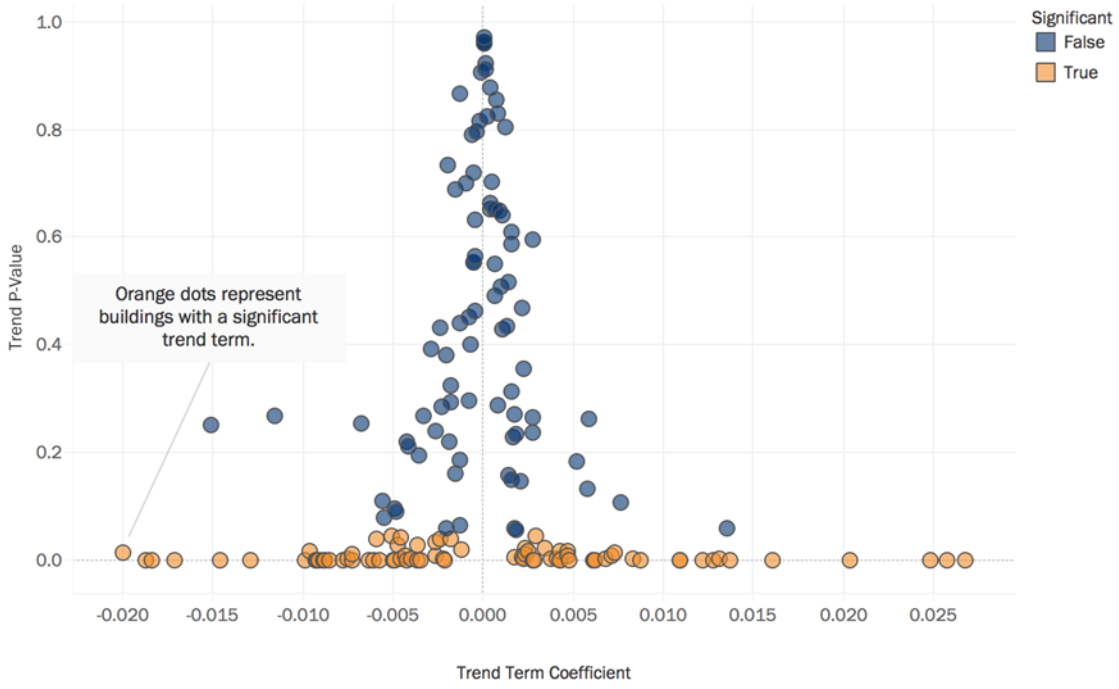
estimated absolute (kWH) gross savings by multiplying this percent savings value by that building's average annual pre-period consumption.

Identification and Mitigation of Pre-Existing Consumption Trends

Without comprehensive data on all aspects of building functioning, the evaluation team could not explain all secular trends in building consumption. Instead, we established clear guidelines for identifying if such a trend did exist, and if so, how to minimize the impact on the final results. We accomplished this by first running a regression analysis (identical to the primary regression analysis but conducted separately and applied only to pre-enrollment period data) with a trend term included in the model specification. We then analyzed these results, and identified all buildings with a significant trend coefficient (i.e., the p-value for the term was less than 0.05). As shown in Figure A-4, there was a wide range of trend term coefficients, both negative (indicating negative trends) and positive (indicating positive trends). Overall, a total of 81 buildings had a significant trend term. Of these, just over half (43) were negative and just under half (38) were positive.

For any buildings with a significant pre-enrollment period trend term, we used only 12 months of pre-enrollment period data when conducting the primary regression. This served to minimize the effect of any secular trends while not completely discarding this data. This adjustment thus resulted in a more conservative estimate of savings when compared to results utilizing the full pre-enrollment period data for all buildings.

Figure A- 4. Building-Specific Pre-Enrollment Period Trend Terms



Sample Versus Population

The evaluation team estimated gross savings at the building level using site-specific time series analyses of monthly billing data. Using this approach, there was a trade-off between quantity of participants we could

include in the analysis and the quality of data included in the energy model for each participant. On the one hand, we could use monthly billing data and available program tracking data to estimate savings for all participants, without controlling for all available potential factors that affect energy usage. On the other hand, we could develop detailed models that control for all measured changes that affect energy usage for a sample of participants we interview to collect detailed data about changes in building occupancy, usage and equipment. There are potential benefits to both approaches. Including all participants in the analysis precludes the need to extrapolate the savings from a sample to the entire population. Conversely, collecting primary data from a sample of participants may allow us to more accurately model program savings for these accounts.

There have been considerable differences among program participants in terms of engagement with the program, as well as key factors that influence engagement and savings such as enrollment date, location, Smart Energy Now pilot program participation, building ownership, staff turnover, number of facilities, and pre-existing energy management. By including all participants, we avoided the difficulty of defining how representative various participants are of the larger population and can provide richer feedback on how program savings tie to engagement and tenure. However, if there were important changes in building energy usage over the analysis period that were not tied to the program and were not captured in program tracking data (and thus we cannot include in our models), there was potential to over- or under-estimate savings if we only used available program tracking data. In this scenario, it would be preferable to rely on estimated impacts for a sample of participants that we interviewed to collect data on changes in building occupancy and usage.

To understand the trade-off between a sample versus the entire population, we designed a two-prong evaluation approach that allowed us to test the feasibility of estimating savings for all participants using available program data. At a high-level, the steps of this approach were as follows:

1. Estimate savings for a sample of participants using data collected through in-depth interviews (as well as program tracking, weather and time variables).

2. Estimate savings for this same sample of participants using only program tracking data (as well as weather and time variables).

3. Compare results from two methods.

    a. If, in aggregate, results from approach #2 are close to those from approach #1, use approach #2 to estimate savings for remaining participants.

    b. If, in aggregate, results from two methods are different, extrapolate results from approach #1 to population.

For approach #1 above, the evaluation team conducted interviews with stakeholders from a sample of 50 accounts to collect information on changes in building occupancy, usage, and equipment over the analysis period. We then conducted a site-specific time series analysis of monthly billing data to estimate gross energy savings at the building level for each sampled participant. Our analysis controlled for weather, time, and the changes in occupancy or operation identified through our interviews, thus allowing us to identify coincident changes in energy consumption for each sampled participant. This approach captured the energy savings associated with changes in building operation and management (e.g., improvements to energy management systems) but also captured building-specific changes that might not be reported (e.g., other system upgrades). This approach allowed our analysis to account for such changes that might otherwise be omitted in the broader analysis.

For approach #2 above, we estimated the same types of models, but dropped all variables based on stakeholder interviews and replacing with data about occupancy that were available in the program tracking data. We compared the results of the two approaches to understand how close we could come to estimating savings by relying solely on program tracking data.

After running these analyses, the evaluation team determined that the differences between the two approaches were not sufficiently large to justify using the restricted dataset. Many of the variables in the interview dataset (e.g., whether or not a building had HVAC controls) were constant over time, thereby limiting their use for a building-specific regression model which relies on changes over time to account for differences in consumption. Only 4 of 50 accounts for which we had interview data had any sort of non-routine change that was not captured through the program tracking data. Furthermore, such an approach would have required us to extrapolate upward to the population using a small number of data points in some strata. Ultimately, we decided that using the full dataset would actually decrease error in the final results, given that much less extrapolation was required to obtain a program-level savings value.

Appendix B. Detailed Findings

Detailed Gross Impact Evaluation Findings

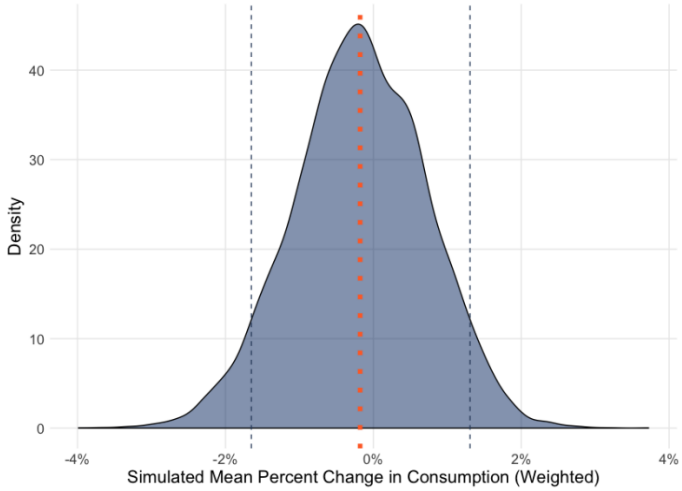
In this section we provide detailed results pertaining to the gross impact evaluation that were not presented in the main body of this report. We first provide a discussion of how we measured uncertainty in the model efforts. We then report on additional analyses conducted to better understand drivers of energy savings through SEiO.

Quantifying Uncertainty in the Main Regression Analysis

To better understand the extent of uncertainty in our energy savings estimates, we conducted a bootstrapping analysis of the estimates of percent change in annual consumption across all buildings included in the sample.[43] The bootstrap method relies on a simulation procedure in which a number (in this case, 10,000) of samples are "re-sampled" from the original data. From this re-sampled distribution it is possible to obtain approximations of the error associated with the original estimate (in this case, the mean percent change in consumption). We conducted this analysis separately for two groups of buildings: (1) non-SEN pilot buildings and (2) SEN pilot buildings. Results are shown below as "density plots" with the mean value indicated as an orange dotted line and the 90% prediction intervals indicated as blue dashed lines.

As shown in Figure B-1, we see that for non-SEN buildings, the 90% prediction interval for the mean percent change in annual consumption extends from -1.3% to +1.8%. This implies that while our best estimate of the mean value is +0.2%, we cannot rule out the possibility that this value may lie elsewhere in this range.

Figure B- 1. Density Plot Showing 90% CI for Non-SEN Buildings' Average Annual Percent Change in Consumption



[43] More specifically, we conducted a non-parametric bootstrap in line with the method discussed by Efron (1992). See Efron, Bradley. "Bootstrap methods: another look at the jackknife." *Breakthroughs in statistics*. Springer New York, 1992. 569-593.

Similarly, as seen in Figure B- 2, we see that the 90% prediction interval for SEN buildings' average annual percent change in consumption is centered around the mean (-4.5%) but extends from -7.4% to -1.1%. Because the 90% prediction interval does not span zero, we can be reasonably confident that savings exist in this group.

Figure B- 2. Density Plot Showing 90% CI for SEN Buildings' Average Annual Percent Change in Consumption

Additional Regression Analysis: Savings Drivers

In addition to the primary regression analysis presented in the main body of this report, the evaluation team ran several additional analyses to better understand what might increase the likelihood that a building will save energy through the SEiO program. We conducted this regression using percent change in consumption (adjusted for savings from other non-SEiO programs) as the dependent variable. Predictor variables included the number of building operator campaigns, the number of tenant campaigns, the number of months of tenure, whether or not the building had been a SEN Pilot participant, whether or not the building had participated in benchmarking, and energy use intensity (EUI, measured in kWH/s.f./year). The results of this regression are shown below in Table B- 1.

Table B- 1. Savings Drivers Regression Results – Adjusted Savings Values

Predictor Variable	Estimate	Standardized Estimate	p-value	Significant?
Number of Operator Campaigns	-0.032	-0.742	0.08	No
Total Operator Award Points	0.000	-0.051	0.17	No
Number of Tenant Challenges	-0.041	-0.956	0.25	No
Tenure (number of months)	-0.002	-0.088	0.42	No
SEN Pilot Participant?	0.059	-0.018	0.79	No
Benchmarking Participant?	-0.018	-0.083	0.35	No
Baseline Energy Use Intensity	**-0.002**	**-0.246**	**<0.01**	**Yes**

The results of this regression indicate that of all the variables tested, baseline EUI had the only statistically significant association with energy savings. Other global relationships tested were not significant. However, as discussed in the body of this report, we did find a marginally significant effect for the length of tenure on savings (weighted by consumption) for engaged participants.

Detailed Process Evaluation Findings

This section provides detailed process evaluation findings that are not presented in the body of the report.

Program Activity for Evaluation Population Only

In Section 6.3 above, we presented results on all campaign activity for all program participants, regardless of whether they had been included in the billing analysis or not. Figures B-3, B-4, and B-5 show this information for only customers that had enrolled in the program early enough to be included in the billing analysis.

Figure B- 3. Total Building Operator Campaigns Implemented by Month (Evaluation Population Only)

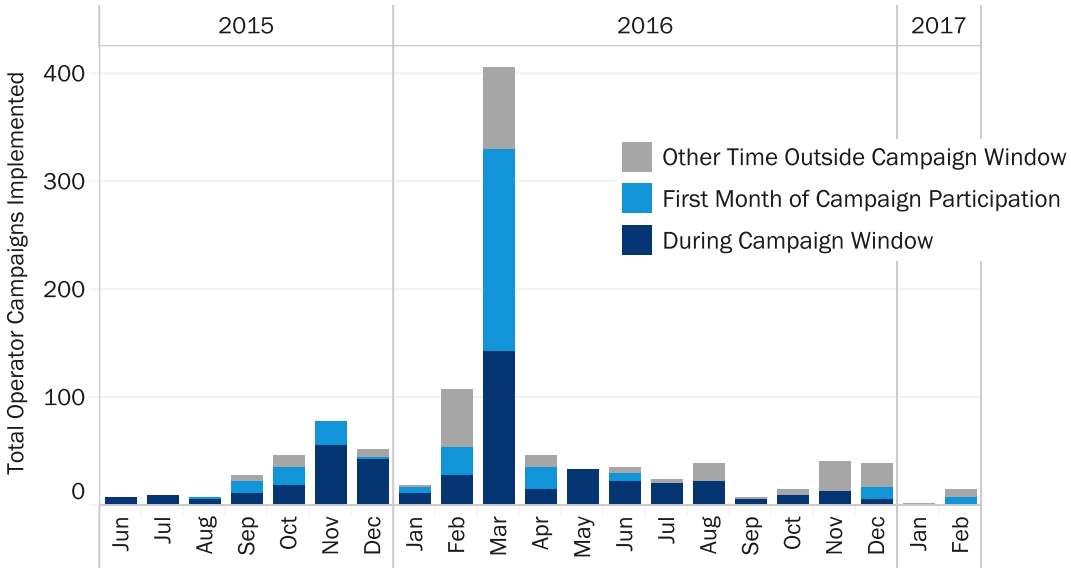


Figure B- 4. Distribution of Unique Online Tenant Challenge Users per Building

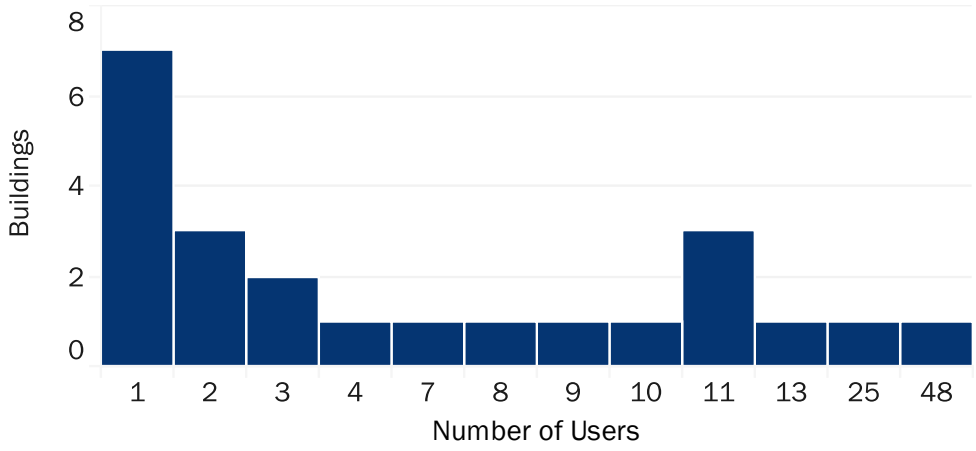
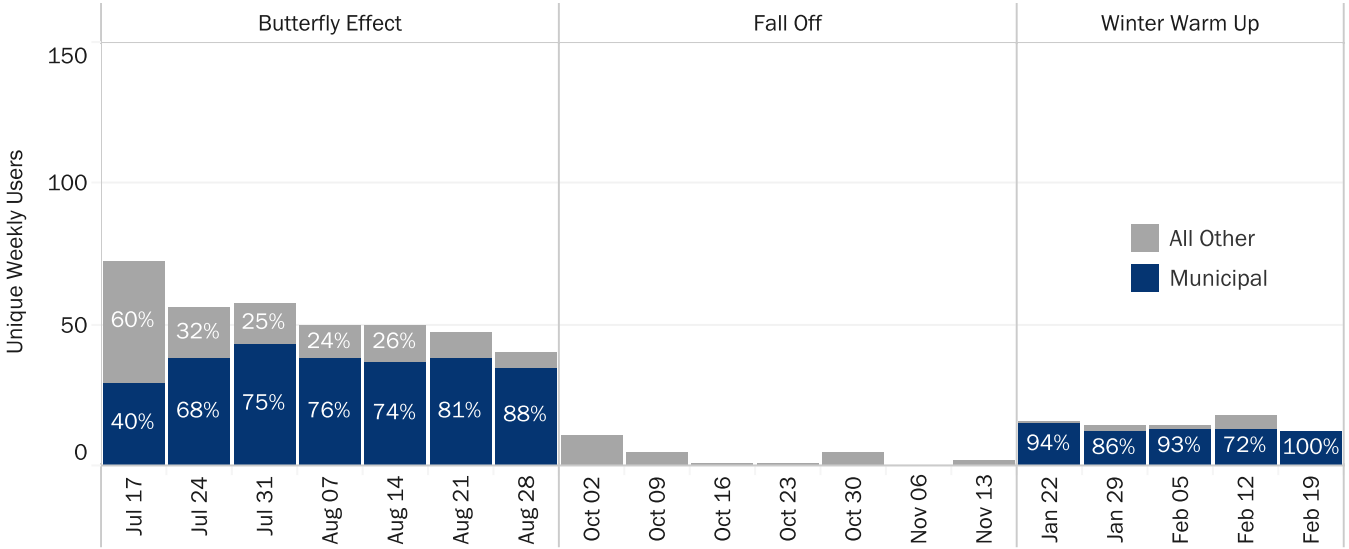


Figure B- 5. Total Tenant Challenge Users by Week (Evaluation Population Only)



Appendix C. Data Collection Instruments, Sampling Plan, and Deemed Savings Review

Building Operator and Coach In-depth Interview Guide

Duke Energy Participant

Building Operator and Coach Survey Instrument

Duke Energy Operator Coach

Building Operator and Coach In-depth Interview Sampling Plan

Duke Energy Sampling Plan

Tenant Survey Instrument

Duke Energy Tenant Survey

Deemed Savings Review

Duke Energy Deemed Savings

CERTIFICATE OF SERVICE

I certify that a copy of Duke Energy Carolinas, LLC's Application for Approval of Demand-Side Management and Energy Efficiency Cost Recovery Rider and Supporting Testimony and Exhibits, in Docket No. E-7, Sub 1164, has been served by electronic mail, hand delivery or by depositing a copy in the United States mail, postage prepaid properly addressed to parties of record.

This the 7th day of March, 2018.

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