

MEMO

Date: November 13, 2020
To: Board of Directors
From: Dan Rubado, Evaluation Project Manager
Peter Schaffer, Planning Project Manager
Alex Novie, Measure Development Manager
Subject: Staff Response to Market Transformation Study of Thermostat Optimization Services

The market transformation assessment completed by Apex Analytics in August 2020 concluded that Energy Trust and the broader utility industry helped create a market for residential smart thermostat optimization services in the US and had a material influence on their development, trajectory, and scale. Thermostat optimization algorithms are software services for existing thermostats that help customers deepen their energy savings beyond the level of savings achieved by the thermostat alone. These services are deployed by manufacturers on an opt-in basis and make automated adjustments to customers' setpoints and schedules. Apex surveyed three top companies providing optimization services in the US: Google Nest, ecobee, and Resideo. Energy Trust has worked with these firms at various levels of engagement on program design, implementation, and evaluation since 2017.

This research established that Energy Trust enabled optimization services by driving broad adoption of smart thermostats in Oregon. For nearly eight years, Energy Trust has supported the installation of smart thermostats, through pilot studies, marketing, and cash incentives. This support helped build the device base of Google Nest and ecobee thermostats. In addition, Energy Trust and the utility industry's pilot studies, financial support, and involvement with thermostat optimization services influenced manufacturers business plans. Google Nest and ecobee's optimization services are both now offered free of charge to all US customers. Resideo continues to operate their service using a program administrator model where Energy Trust pays a fee per participating device—thus there is currently no market transformation rationale for Resideo.

Energy Trust interpreted these findings as justification to claim market transformation energy savings for Google Nest and ecobee thermostat optimization services for the entire base of installed devices in its service territory for a limited time. The market transformation savings for thermostat optimization services are a function of per-device savings by season (e.g., heating or cooling), opt-in rates, and the size of the applicable thermostat device base. For per-device savings values and opt-in rates, Energy Trust's Residential team at CLEAResult leveraged recent evaluations of Google Nest and ecobee optimization services.^{1,2} Energy Trust is claiming only cooling season market transformation savings for ecobee devices in 2020 as the available research only assessed cooling savings. Energy Trust may include heating savings for market transformation claims for applicable ecobee devices in future years if they are proven out. Energy Trust's Residential team estimated the current installed device base in Energy Trust service

¹ Demand Side Analytics. 2019. Eco+ Thermostat Optimization Pilot. Retrieved on 11/13/2020 from: <https://www.ecobee.com/assets/static/eco-EMV-Executive-Summary-20e4e62c30a41ae00d7c430c24335532.pdf>.

² Apex Analytics and Demand Side Analytics. 2017. Energy Trust of Oregon Nest Seasonal Savings Pilot Evaluation. Retrieved on 11/13/2020 from: <https://www.energytrust.org/wp-content/uploads/2017/12/Energy-Trust-of-Oregon-Nest-Seasonal-Savers-Pilot-Evaluation-FINAL-wSR.pdf>.

territory and the projected growth of installed thermostats over several years, using data from manufacturers and third-party market forecasts. The estimated number of devices that will continue to opt-in to optimization services informed the applicable number of devices for market transformation savings claims each year.

Apex’s qualitative study did not establish how much the utility industry accelerated the roll-out of Google Nest and ecobee optimization services, or the duration of any market transformation savings claims. Energy Trust and its stakeholders, including its Board Evaluation Committee and the Northwest Energy Efficiency Alliance, agreed that three years would be a reasonable time horizon, given that Energy Trust worked with Google Nest to deliver thermostat optimization savings over a three-year period. Energy Trust will claim market transformation savings from 2020 to 2022 in three separate batches as follows:

- The 2020 market transformation savings claim will be based on the total number of applicable Google Nest and ecobee thermostats installed in Energy Trust’s service territory expected to opt-in. Energy Trust’s Residential Program will claim 2.6 million kWh and 610,000 therms of market transformation savings in 2020 with a three-year measure life.
- The 2021 market transformation savings claim will be limited to newly installed thermostats that do not go through the program only. Since optimization savings will be baked into the deemed savings of program incentivized thermostats starting in 2021³, program devices must be removed from the count of new thermostats to avoid double counting savings. The Residential program expects to claim 220,000 kWh and 82,000 therms of savings in 2021 with a two-year measure life.
- The 2022 market transformation savings claim will also be limited to newly installed, non-program thermostats only. The Residential program expects to claim 280,000 kWh and 88,000 therms of savings in 2022 with a one-year measure life. Thus, all market transformation savings claims for Google Nest and ecobee devices will be contained within the three-year period from 2020-2022.

The table below shows the first-year market transformation savings that Energy Trust plans to claim each year by manufacturer, heating or cooling season, and the estimated number of applicable devices.

Year	Manufacturer	Season	Estimated Applicable Devices	kWh Savings	Therm Savings
2020	Google Nest	Heating	41,190	1,718,300	609,900
		Cooling	33,030	135,400	0
	ecobee	Cooling	19,290	771,700	0
2020 Savings sub-total				2,625,400	609,900
2021	Google Nest	Heating	5,650	186,400	82,200
		Cooling	4,450	18,200	0
	ecobee	Cooling	420	16,700	0
2021 Savings sub-total				221,300	82,200
2022	Google Nest	Heating	6,040	247,600	87,900
		Cooling	4,760	9,200	0
	ecobee	Cooling	510	20,500	0
2022 Savings sub-total				277,300	87,900
Total First Year Savings 2020 - 2022				3,124,000	779,800

³ Beginning in 2021, Energy Trust will incorporate thermostat optimization savings as part of the deemed savings value for each incentivized Google Nest and ecobee thermostat. The market transformation claims for 2021 and 2022 will be net of any devices incentivized by Energy Trust during those years. Energy Trust will continue to pay for the optimization of Resideo thermostats on a per device basis each year.

To: Dan Rubado, Phil Degens, Energy Trust of Oregon
From: Noah Lieb, Joe Van Clock, Scott Dimetrosky, Apex Analytics
Subject: Market Transformation for Smart Thermostat Optimization Services
Date: August 20, 2020

Introduction

Energy Trust commissioned Apex Analytics to conduct a qualitative assessment to determine program administrator and Energy Trust market transformation influence related to smart thermostat optimization services. This memo details the research objectives and methodology, provides background to this research and to the different optimization services, and summarized the key findings, conclusions, and recommendations.

Research Objectives

The primary goal of this research was to qualitatively assess the market transformation influence of the utility industry, and Energy Trust, on the trajectory, development, and scale of smart thermostat optimization services. A secondary objective was to estimate participant direct effects of optimization service savings attributable to Energy Trust's thermostat incentive programs. Although primarily focused on Google Nest's Seasonal Savings service, Energy Trust also wanted to investigate their influence on ecobee's eco+ service and Resideo's Connected Savings service. In addition to this overarching research goal, this research was conducted to address the following questions:

- › Did the utility industry influence the trajectory, development, and scale of optimization services?
- › Would Nest have rolled out, and later expanded optimization services to all customers, without early research and support from program administrators? Did that support affect the timing of activities in this market?
- › Will the manufacturers continue offering these services into the future?
- › How are thermostat optimization and demand response services interrelated?
- › What are the incremental optimization savings Energy Trust can claim from the participant direct effects of their smart thermostat programs?

Approach

Our approach to the research objectives includes two primary aspects, assessing the non-participant market transformation effects (qualitative) and the participant direct effects (quantitative). These two research elements are described separately below.

Assessment of Non-Participant Market Transformation Effects

Apex conducted five in-depth interviews for this assessment with the three primary smart thermostat manufacturers that provide thermostat optimization services (Nest, Resideo, ecobee). Apex worked closely with Energy Trust staff to determine which staff within the smart thermostat manufacturers might provide the most insight into Energy Trust's role. In general, staff selected for interviews had direct knowledge of business decisions made regarding the optimization service, had been with the company and focused on either the business development or product development since launch of the service, and have deep understanding with utility industry partnerships.

Apex drafted an interview guide with interview questions for each manufacturer. We used the interview guide as a framework for structured, in-depth interviews with representatives from each manufacturer. We customized interview questions for each manufacturer, since each has had a different trajectory in the optimization market, and each had varying levels of involvement with Energy Trust.

Apex relied primarily on the findings from the in-depth interviews with supplemental review of archived emails, communications, marketing materials, or feedback from market actors (primarily other evaluation firms or program administrator programs involved in smart thermostat research). Apex then used the collective findings to assess whether, and to what extent, the utility industry (and Energy Trust) influenced the evolution of the optimization services, the timing of their adoption, the magnitude of the programs and their expansion, and associated transformative elements of Energy Trust's involvement in these efforts.

Quantifying Participant Direct Effects

As noted above, one of the objectives of this memo is to determine Energy Trust's influence broadly across the thermostat optimization market for customers outside of any program participation. Another objective is to quantify the direct effects of Energy Trust's program activity in the thermostat optimization space. Energy Trust has provided retail, online, and direct-to-consumer incentives and offers for smart thermostats in residential settings since 2015. Apex identified and calculated the direct relationship between a smart thermostat hardware incentive and any resulting optimization service savings in the future that would fall outside of program optimization service savings claims (therefore directed at Nest and ecobee thermostats). Apex summarized attribution (free-ridership), participant opt-out rates, and calculated the participant direct effect estimate for Energy Trust's various program offerings specific to each of the thermostats (Equation 1). This participant direct effect estimate looks at the number of smart thermostats installed with the influence of Energy Trust incentives and the future optimization savings that those efforts make possible. This analysis applies the known optimization service opt-out rates and does not incorporate any estimate from the qualitative non-participant market transformation component described above.

Equation 1. Participant Direct Effect Calculation

Participant Direct Effect

$$= (\# \text{ of thermostats} \times \text{gross per thermostat savings} \times \text{NTG} \times \text{opt} - \text{in rate})$$

Study Background

Thermostat optimization (TO) algorithms are software services that manufacturers deploy on existing smart thermostats to achieve additional energy savings above and beyond the base level of savings associated with smart thermostat devices. To accomplish this, these algorithms scan user schedules for inefficiencies and make automatic setpoint adjustments, driving deeper setbacks during times when occupants are least likely to notice (e.g. away or asleep). Energy Trust has supported various optimization services over the past several years. This includes funding a large-scale implementation of Google Nest's Seasonal Savings service in Oregon since a pilot study in 2016/2017 and recently completing a pilot study of Resideo's Connected Savings service.⁴ These services now comprise a large amount of residential energy savings, although they are only claimed for a single year at a time. Additionally, Energy Trust has enabled broad adoption of smart thermostats, generally, through pilots, marketing, and cash incentives for nearly eight years.

Smart thermostat manufacturers have two primary business models for optimization services: offer the service embedded as a feature bundled with the thermostat natively (native model), or as a service through program administrator partnerships, to monetize the service via program administrator-based programs (program administrator model). Table 1 shows the approaches each of the three major manufacturers took in the development of their optimization services and how those approaches have evolved over time.

Table 1: Thermostat Manufacturer Approaches to Optimization Services

Manufacturer	Initial Approach	Current Approach
ecobee	Native Model	Native Model
Google Nest	Program Administrator Model	Native Model
Resideo	Program Administrator Model	Program Administrator Model

Given the market developments noted above, there is a great deal of uncertainty around the relative influence of program administrator partners supporting thermostat optimization programs. Specifically, Energy Trust and the utility industry contributed to the expansion of Google Nest's Seasonal Savings service and Resideo's Connected Savings service. It is unclear how much these services would have expanded (or been developed in the first place) in the absence of utility industry support.

Furthermore, the existence, functioning, and savings associated with the optimization services are tied directly to the installation of these thermostats. In other words, without a smart thermostat there can't be any optimization, so Energy Trust is (and will continue to

⁴ Nest SS study link, Resideo study link

be) directly responsible for optimization savings for thermostats installed as a result of their programs and the effect may carry into the future. This participant related “direct effect” is independent of any role Energy Trust may have had in development of the optimization services.

Energy Trust commissioned this assessment of market transformation influence on optimization services to assess whether Energy Trust is justified in claiming non-participant-based market transformation savings from thermostat optimization services and to estimate the participant “direct effects” of the smart thermostat incentives on optimization savings. The assessment also includes a summary of the direct effects savings resulting from Energy Trust’s smart thermostat programs.

Platform Background

A brief overview of the three primary optimization platforms provides context to the initial development, decisions around business model choices, relationships between the services. The three optimization platforms designed their services around two business models. The two business models have unique considerations, benefits, and costs associated with different attributes, as reviewed below in Table 1. As optimization services evolved, some of these attributes associated with each model may not have been clear at the outset from the earlier offerings of the optimization service, and only realized after experience within the market.

Table 2. Optimization Service Attributes and Business Model Comparisons

Attribute	Advantages / Disadvantage	Native	Program Administrator
Reach of service	Advantage	Broader reach, to all potential customers. Benefits accrue to customers (direct) and program administrators (indirect).	Partnership may increase awareness and uptake.
	Disadvantage	Unknown whether reach of service may have been constrained w/out first having had program administrator pilots paving path.	Limited reach only to program administrator partners that have the ability to claim additional savings.
Monetization / revenue	Advantage	Avoids program administrator engagement costs (contracting, admin, legal, outreach, data); add customer value, native savings offers potential marketing benefits (longer-term).	Direct revenue stream.
	Disadvantage	Limited monetization (short-term)	Program administrator engagement costs (contracting, admin, legal, outreach, data, marketing – often contractually required to market service in collaboration with PAs).
Enrollment	Benefits	Easier, light touch, single click opt-in/out.	Connect with receptive customers through program admin, early adopters.
	Costs	N/A	Historically greater challenges, terms and conditions, adds “friction”
Awareness of optimization service features and benefits	Benefits	Not limited to program administrator partners, so broader awareness possible (long-term).	Awareness raised through program administrator partnerships, additional marketing through programs.
	Costs	Requires establishing awareness outside of any utility partnership model, marketing, outreach internally, no partnerships.	Limited to program administrator partners.
Trust	Benefits	Through customer engagement, brand recognition.	Through brand recognition and program administrator engagement, program efforts, 3 rd party verification of savings via utility evaluation.
	Costs	Requires funding 3 rd party verification of savings, trust requires longer-term brand engagement.	Some customers do not and will not trust program administrators.

Nest was the first entrant into the optimization market, piloting and beta testing the service in 2012.⁵ According to Nest staff, the optimization concept was framed as a program administrator-funded service, though there was some debate as to whether the potential revenue stream would be sufficient to justify the resources to develop it or if Nest should pursue a native model. At that time, Nest staff believed the latter option had the potential to save more energy, but a program administrator model would help fund the development

⁵ Google Nest, April 2013, Seasonal Savings White Paper, available online at https://storage.googleapis.com/nest-public-downloads/seasonal_savings_white_paper.pdf

costs. In addition, program administrator partners would help raise awareness, increase early adopter uptake, and provide additional validation to the performance of optimization services. Importantly, for a tech startup like Nest (at the time, not affiliated with Google), identifying an alternate revenue stream for this service showed promise. Ultimately, Nest made the decision to roll out the Seasonal Savings service as a program administrator cosponsor approach.

After several years of offering the service and Google's acquisition of Nest, the larger company determined that providing optimization as a service via the program administrator model was hard to justify due to increasing costs. These costs included complex program administrator contracting, the resource costs to market and sell it to utilities, and the regulatory and evaluation requirements. Collectively, these costs meant that Google Nest was ultimately losing money on Seasonal Savings. With at most 20 deployments in any given year – Google Nest determined the service was no longer worth the limited revenue. For Google Nest, the “bureaucracy of program administrator-driven energy efficiency” helped drive the stake in the heart of the program administrator partnered optimization service. Faced with the decision to either shut down the service or take a native approach, Google Nest opted to roll it out universally to all Nest users.⁶

Resideo's Connected Savings optimization service originated as more manual, user-driven service by Earth Networks in 2012. Earth Networks recognized value in managing household energy load based on their knowledge of thermostats, HVAC systems, and weather. Earth Networks could offer a hardware agnostic service with the goal of monetizing the service through program administrators' energy efficiency budgets and interest in identifying new opportunities for energy savings. Earth Networks developed the tools to inform customers on how to drive savings, using a modelling and forecasting process, but it was still up to the customer to adjust their setpoint preferences. Eventually, as Earth Networks evolved into Whisker Labs and later into Resideo, this service transitioned from user-driven to thermostat automated via the Connected Savings service (in 2016). Regardless of the approach, the program administrator model has always been Resideo's targeted client for this service. According to Resideo, the program administrator model offered the “carrot” of robust energy savings and early pilot testing helped validate the optimization service.

ecobee was the last entrant into the thermostat optimization service market rolling out their eco+ service in 2019. Previously, ecobee had only indirectly participated via other third-party optimization services (which included Resideo) because of an open API policy. ecobee developed eco+ with a customer-centric approach (as a native feature) yet recognized that they were building the eco+ business model in contrast to the business models offered by other optimization services already in the market. ecobee's goal was to package multiple advanced thermostat features to provide intelligence, help users save money on energy, and help bring value to differentiate their thermostat products. Another factor was to continue to provide grid services, allowing compatibility with existing DR services and therefore any platform to perform DR on the thermostats. ecobee views the bundled thermostat features – energy efficiency in the form of optimization, demand response, time of use together, as one consumer facing experience. This approach allowed their value proposition to be both program administrator/grid and customer focused. The goal was to

⁶ Google Nest, June 2020, <https://blog.google/products/google-nest/seasonal-savings-nest-thermostat/>

have higher customer engagement in the service – therefore increased impact both with customer bill savings and participation in utility BYOT programs and TOU rates.

Findings: Non-Participant (Market Transformation) Influence

Whether the utility industry (and program administrators) influenced thermostat optimization services is not strictly a binary question but involves varying levels of influence across different components of the market lifecycle. To determine influence, we have to ask whether program administrator engagement affected the timing, trajectory, evolution, and scale of the optimization service. These market transformation factors are based off of NEEA’s market transformation approach, which defines key points of a market adoption model.⁷ These distinctions are important aspects of gauging market transformation influence, and can be addressed by asking more pointed questions:

- › **Timing:** Without program administrator engagement, would optimization services still have been developed and rolled out under the same time horizon?
- › **Trajectory:** Without program administrator engagement, would optimization service uptake still have moved at the same rate along the adoption curve?
- › **Evolution:** Without program administrator engagement, would optimization services still have saved the same amount of energy per home?
- › **Scale:** Without program administrator engagement, would optimization services still have reached the same number of households?

Apex organized each of these market transformation factors according to the respective thermostat manufacturer. A summary of the program administrator market transformation factors by manufacturer are listed Table 2 and described in greater detail with supporting evidence below. We assigned any influence as “direct” for the manufacturers that have partnered with program administrators (Nest, Resideo) and as “indirect” for those not having partnered (ecobee).⁸

Table 3. Summary Program Administrator Market Transformation Influence Factors by Thermostat

MT Influence Factor	Ecobee	Nest	Resideo
Timing	Indirect	None	None
Trajectory (rate of adoption)	Indirect, shifted adoption curve	Direct, shifted adoption curve	Direct, shifted adoption curve
Evolution	Yes, moderate	No	Yes, moderate

⁷ Van Clock, J, Moran, D, Steinhoff, C. August 2018, ACEEE Summer Study, Building a Foundation on Moving Ground: Five Easy Steps to a Market Transformation Baseline, available online at <https://www.aceee.org/files/proceedings/2018/index.html#/paper/event-data/p234>

⁸ This distinction does not indicate the degree of influence nor does it relate to the quantification of participant direct effects.

Scale (maximum potential adoption)	Indeterminate	Indeterminate	Indeterminate
Marginal ETO influence	Average	Average	Average
Evidence for MT influence	Yes, indirect	Yes, direct	Yes, direct

We then summarized the manufacturer remarks regarding each of the market transformation elements, as detailed in Table 3 below.

Table 4. Detailed Program Administrator Market Transformation Influence Factors by Thermostat

Factor	ecobee	Nest	Resideo
Timing	Reasonable to assume earlier pilots may have influenced the timing for development and launching of eco+. PA support in general has played important role and allowed ecobee investment in these services.	Nest had already developed the service and conducted in-house beta testing. Noted that without PA support may not have rolled out service, so did have some effect on timing.	Similar to Nest, Resideo (Earth Networks) had developed the service and conducted in-house beta testing. No effect on timing.
Trajectory	Because ecobee was last entrant into market, their service evolved based on market outlook and experience of others. Reasonable to assume pilots influenced the trajectory for eco+, especially as it concerns business model and go to market strategy.	PAs had a role in validating savings, large scale randomized controlled trial pilots across different climates. While Nest believed market evolved naturally, PA contribution played a role in trajectory. If PAs were not partners – unsure if Nest would have still offered it and deployed it for free. Traction, and PAs, leading the charge – MA, CA, ETO – helped keep service alive; if market had shrunk, would have shut it down.	Quicker to monetize with consumers via program administrator model. PA model shifted adoption curve.
Evolution	Limited evidence pointing to PA influencing the optimization algorithm and resulting per home savings. Could be marginal indirect influence based on previous studies but highly uncertain.	No evidence to indicate program administrator influenced the optimization algorithm and resulting per home savings. Could be marginal indirect influence based on pilot studies but highly uncertain.	Energy Trust study helped target winter optimization strategy (nighttime setbacks), but direct PA influence was small.
Scale	If service is native, then will achieve greater enrollment, translating into higher EE savings. Even if longer-term PA model didn't make business sense, it did influence scale. Continued support for EE incentives and the need to buoy EE savings to qualify for those incentives did play a part in the decision to build in these features natively.	Indeterminate. Uncertain whether service would have achieved greater saturation without PA model.	Energy Trust is helping the most w/ conversion rates; Resideo now has the technology to offer simplified participant entry, using a one-click in app participant opt-in feature. With this level of simplicity, the conversion rate is expected to quintuple. Energy Trust is the first to pilot this approach.

Note "PA" in this table refer to Program Administrators. We use this abbreviation to limit table space.

- › *Would Nest have rolled out, and later expanded optimization services to all customers, without early research and support from program administrators? Did that support affect the timing of activities in this market?*

Google Nest reported that, had program administrators not been interested in thermostat optimization, it is doubtful they would have initially offered it natively and deployed it for free. As noted above, Google Nest stated that they originally weighed the decision to roll-out the optimization service natively to all thermostats or to monetize it and offer it as a program administrator-driven program. At that time (2012), the service existed and had already been beta tested and validated via a white paper. The unknowns at that time were customer awareness and perceptions of the service, what the enrollment opt-in rates would be, and how this service would perform under different demographic groups, regions, HVAC systems, and household types. Google Nest chose the program administrator partner model and continued down that path for eight years.

Program administrator support did not affect the timing for the development and release of Nests Seasonal Savings though it likely had an impact on the trajectory of this service. The program administrator contribution to optimization services included increasing ratepayer awareness of the thermostats and optimization services, process and impact evaluations to inform the satisfaction and user issues of the services and validate energy savings, while adding in another element of trusted voice to lend credence of the offering. There is a lot of value in the momentum gained from numerous program administrator programs. This momentum translates into a shifted adoption curve, though it is unclear to what extent. From Google Nest's business development aspect, program administrator involvement was not the end goal, they recognized that the service was priced cheaply and not going to be a profit center. The goal was to allow a refinement of the service over time, mostly driven by program administrators. Even with 3rd party evaluation playing a significant role in validating the optimization service, there were still plenty of program administrators unwilling to participate and Google Nest did not see a bump in enrollment as a result.

Though not directly related to Google Nests decision to pursue the program administrator model, evidence from our interviews with ecobee and Resideo help provide perspective on the evolution of the optimization service market. According to Resideo, program administrators are the sole path to monetization for optimization services. Resideo has stated that the value in partnering with program administrators versus natively offering the service bundled in thermostats includes adding credibility, increased awareness, and establishing a market that may not have been ready to widely adopt without program administrator support.

ecobee viewed the optimization market as constrained by a limited number of pilots, therefore lacked sufficient trajectory to continue as a stand-alone offering. Yet, ecobee also believes some credit should go towards those utilities investing in pilots, of which Energy Trust was an early adopter, which helped pave the way for broader adoption of optimization services. This influence, particularly for Energy Trust for the Oregon region, included their resources for implementation and evaluation of this service (e.g., time, research, support). Therefore, the validation of the optimization services through utility opportunities served as a critical piece for ecobee's justification to invest in these services; as ecobee noted, "broadly, without question, because these opportunities were there, we could invest in

them, and offer the service as an out of box feature – [program administrator] influence is the reason they are here.”

Yet, ecobee also noted that while the business model for program administrator optimization services had challenges and limited uptake, the optimization as a service has prevailed. According to ecobee, even though all stakeholders received some benefits from this model (customer, program administrator, and service providers), the program administrator model involved too much customer and program administrator “friction”. This friction included contracting, legal, terms and conditions, and a challenging opt-in process. ecobee’s solution was to offer an out of the box service, where the customer can engage with the suite of energy features with limited decision points, resulting in very high participation and higher engagement with the service.

› ***Will smart thermostat manufacturers continue offering optimization services into the future? For how long?***

Nest indicated it will continue to move forward with their native features offering the optimization to all of their users, outside of any program administrator model. The Resideo strategy is unchanged and will continue offering the Connected Savings as a program administrator partnership model for the foreseeable future. Resideo still believes that program administrators remain the sole path to monetization for the optimization service. Resideo believes there are still benefits to working with Energy Trust and program administrators – the service will remain independently quantifiable, with direct attribution, while delivering benefits that customers can turn on and program administrators only pay for the savings they are generating. ecobee will continue to offer this service as a native offering of their thermostats for the foreseeable future. A critical feature for ecobee is for the customer to retain control. If programs could offer a more holistic and customer centric approach, allowing users to select comfort preferences, with easier opt-outs, and a flexible platform, then ecobee believes that they would still consider looking at partnering with program administrators for future efforts.

› ***Is there any evidence to support Energy Trust having differentiated influence over the trajectory and evolution of optimization services market?***

Assessing market transformation influence across program administrators is complex and fraught with uncertainty and trying to isolate individual program administrator influence is even more challenging. Recognizing this difficulty, NEEA does not differentiate program administrator specific influence relative to the overall utility industry. Yet, our interviews revealed several notable aspects of Energy Trust’s influence in the evolution of the optimization services. As an example, according to Resideo, after more than six years of pilots and partnerships, the 2018 Energy Trust pilot revealed the potential for larger setbacks during winter nights.⁹ Additionally, an upcoming Energy Trust initiative will allow easier one-step enrollment, with the expectation to move to much higher conversion rates.

⁹ Apex Analytics, February, 2020, Energy Trust of Oregon Resideo Thermostat Optimization Pilot Report, available online at <https://www.energytrust.org/wp-content/uploads/2020/04/Energy-Trust-of-Oregon-Resideo-Pilot-Final-Report-wSR-Final.pdf>

Google Nest staff gave Energy Trust’s Seasonal Savings pilot study high marks as the best of its kind and offered the report as evidence to numerous other partners.¹⁰ Staff indicated that this study was the most robust example to demonstrate the Seasonal Savings, with design, evaluation, and validation of the savings. According to Google Nest, Energy Trust’s study had a positive impact on validating savings and the use of runtime-based evaluation. The results of this study showed robust savings and was one of the earlier independent validations of this service. This study paved the way for partnerships with skeptical program administrators playing a significant role to “push them over the hump” and sign on to partner. What is unclear is how many pilots may have signed up as a result of these findings.

The ecobee interview did not provide any indication that Energy Trust had any differentiated influence, relative to the trajectory and evolution of the thermostat optimization services.

› *How are thermostat optimization and demand response services interrelated?*

All manufacturers indicated that demand response (DR) services will continue to be offered and not contingent on their optimization services. For Google Nest, DR is all about program administrators, yet they are now more interested in letting third parties run the DR programs – Google has found that running DR is not a high profit business (at least relative to Google profitability “scale”). Resideo indicated they will continue to support program administrator DR programs as well. Resideo believes you have to have both optimization and DR from a program administrator perspective. With regulated utilities, even if the smart thermostat has native DR features (i.e., opting into the service includes a DR component as well), market actors will still need to enroll customers and comply with regulatory requirements. For ecobee, their eco+ service is a suite of customer-centric services (energy efficiency, TOU and DR together, as one consumer facing experience) providing intelligence to save customer money on energy. The foundation of the eco+ suite is to bring this value directly to the customer while also providing grid services, including compatibility with existing DR programs. The eco+ DR component will allow any utility or DRMS service to administer DR on the thermostats, based on an open API environment. Therefore, utilities or their third-party administrator, will continue to be able to control and dispatch their DR services independently of the optimization service.

Document Review

Apex staff’s review of email communication, white papers, and previous evaluation studies did not identify any supporting evidence for market transformation influence. Even though our document review did not show evidence of explicit discussion of influence from Energy Trust or other program administrators, we cannot use the lack of evidence as an indicator for not having any market transformation influence. We believe program administrator influence may have still occurred even if it wasn’t discussed explicitly in emails about project management, in white papers or evaluation reports. Our documentation review found the following for each of these different sources:

¹⁰ Apex Analytics and Demand Side Analytics, November 2017, Energy Trust of Oregon Nest Thermostat Seasonal Savings Pilot Evaluation, available online at <https://www.energytrust.org/wp-content/uploads/2017/12/Energy-Trust-of-Oregon-Nest-Seasonal-Savers-Pilot-Evaluation-FINAL-wSR.pdf>

- › **Emails:** email correspondence between Apex, Google Nest, Resideo, and Energy Trust included topics such as project management, logistics, implementation clarification, pilot/program/implementation descriptions, but did not include any discussion of the role program administrators were playing or related influence on the optimization service.
- › **White papers:** Apex reviewed white papers from each of the three manufacturers, which detailed findings from their beta testing or initial program administrator pilots of this service. Similar to the emails, these white papers provided information on the methods used to evaluate the service along with energy savings findings but did not include any discussion of the role program administrators were playing nor related influence on the thermostat optimization service.
- › **Evaluation Reports:** Apex reviewed several optimization evaluation reports (including our own). These evaluation reports did not include any discussion of the role program administrators were playing nor related influence on the optimization service. A summary of the evaluation reports reviewed is included in Appendix A: List of Evaluation Reports.

Findings: Direct Participant Effects

As noted above, Energy Trust can claim optimization service savings from both historical and future installations of smart thermostats attributable to their programs. Recent conversations with other administrators indicate they are planning on taking a similar approach, stacking TRM-based optimization savings on top of the thermostat hardware savings. To estimate the savings from participant direct effects, we compiled the following input assumptions:

- › **Thermostats:** For optimization savings associated with historical program activity, Energy Trust provided a total count of program incentivized smart thermostats from 2015 through June 2020.
- › **Free-ridership:** Energy Trust provided the historical free-ridership rate for smart thermostats, which applies only to the "self-install" category only.¹¹ For historical installations, we relied on the historical annual free-ridership rate. For future installations, to simplify the direct effect calculation, we recommend adopting a 39% free-ridership rate going forward, to be updated based on future research. The direct effect calculation relies on the complement of the freeridership percentage, which is the net-to-gross (NTG) ratio, or [1- free-ridership].
- › **Effective Opt-in rate:** Derived from Google Nest participation rates based on Seasonal Savings Impacts in Oregon: Winter 2018/19 memo.¹² This effective rate reflects the percentage of units qualified for optimization savings and opting-in to the service. The ecobee white paper did not report opt-in rates, so we assigned Google Nest rates for this analysis.¹³

¹¹ Energy Trust assumes, consistent with direct install programs throughout the country, that direct install households would not have installed the thermostat in the absence of the free install (therefore zero freeridership).

¹² Google Nest, April 2020, Seasonal Savings Impacts in Oregon: Winter 2018/19

¹³ Demand Side Analytics, November 2019, eco+ Thermostat Optimization Pilot, available online at <https://www.ecobee.com/wp-content/uploads/2020/02/eco-EMV-Executive-Summary.pdf>

- › **Per unit savings:** Gas furnace and heat pump savings based on Google Nest paper from 2018/2019 Seasonal Savings program.¹⁴ Google Nest electric furnace savings derived from gas furnace therm savings converted to kWh (assuming 87% gas furnace efficiency and 100% electric furnace efficiency). The ecobee electric savings were based on the ecobee white paper, which did not report HVAC type nor gas therm savings.¹⁵

A summary of the participant direct effect assumptions for thermostat installations are shown in Table 5 below.

Table 5. Participant Direct Effect Assumptions for Future Thermostat Installations

Delivery Type	Thermostat	HVAC type	Opt-in Rate	NTG	kWh	Therms
Self-install	Google Nest	Gas furnace	61%	61%	11.4	14.3
Self-install	Google Nest	Heat pump	61%	61%	88	0
Self-install	Google Nest	Electric furnace	61%	61%	327	0
Self-install	ecobee	All	61%	61%	40	N/A
Direct-install	Google Nest	Gas furnace	61%	100%	11.4	14.3
Direct-install	Google Nest	Heat pump	61%	100%	88	0
Direct-install	Google Nest	Electric furnace	61%	100%	327	0
Direct-install	ecobee	All	61%	100%	40	N/A

Apex relied on the same assumptions for our projected thermostat savings estimates from historical thermostat installations, which are summarized in Table 6 below. The only difference for the historical installation analysis was the use of annual free-ridership rates rather than the 39% used in Table 5.¹⁶ The total savings in Table 6 reflects the net annual savings from thermostat optimization services for those thermostats installed through one of Energy Trusts programs.

Table 6. Participant Direct Effect Savings for Historical Thermostat Installations

Delivery Type	Thermostat	HVAC type	Total Net Annual kWh	Total Net Annual Therms
Self-install	Google Nest	Gas furnace	50,972	63,939
Self-install	Google Nest	Heat pump	12,442	-
Self-install	Google Nest	Electric furnace	229,761	-
Self-install	ecobee	All	43,290	N/A
Direct-install	Google Nest	Gas furnace	16,843	21,127
Direct-install	Google Nest	Heat pump	68,818	-
Direct-install	Google Nest	Electric furnace	175,233	-
Direct-install	ecobee	All	73,590	N/A

¹⁴ Google Nest, April 2020, Seasonal Savings Impacts in Oregon: Winter 2018/19

¹⁵ Demand Side Analytics, November 2019, eco+ Thermostat Optimization Pilot, available online at <https://www.ecobee.com/wp-content/uploads/2020/02/eco-EMV-Executive-Summary.pdf>

¹⁶ Annual freeridership rates based on Opinion Dynamics, Fast Feedback 22019 report, May 2020, available online at <https://www.energytrust.org/wp-content/uploads/2020/05/Fast-Feedback-2019-End-of-Year-Report-Final.pdf>

Conclusions and Recommendations

There is a clear and unambiguous argument that program administrators, Energy Trust included, can include smart thermostat optimization savings from thermostats incentivized and attributable to their thermostat programs. These participant direct effect savings are readily quantifiable, are based on previously evaluated metrics, and have the support of other jurisdictions following the same approach. There remains some uncertainty around these estimates, including whether the opt-in rates will remain constant, if and how savings may persist,¹⁷ and how the services, since they are software based, will evolve. This latter point is especially relevant with the service being native to the thermostats, as any future thermostat savings estimates will be based on one estimate for the hardware and one for the software features. Therefore, isolating the stand-alone impacts of the thermostat relative to the service in the future will not be possible for Google Nest and ecobee (not Resideo).

Recommendation: For future smart thermostat incentive programs, Energy Trust should claim the incremental optimization service savings consistent with Table 5 summary metrics reported above for ecobee and Nest thermostat installations. For historical smart thermostat incentive programs, Energy Trust should claim the total optimization service savings consistent with summary estimates reported above in Table 6, again, for ecobee and Nest thermostats. Keeping the optimization savings distinct from thermostat savings will ensure a more product agnostic approach. Smart thermostat manufacturers like Resideo, or third-party optimization services like Uplight, who are continuing to offer stand-alone optimization as a program, will therefore receive equal opportunity as Google Nest and ecobee. At this time, there is no need to distinguish Resideo optimization impacts because Resideo plans on continuing to offer this service as a stand-alone feature.

While less clear cut than participant direct effects, and certainly less easily quantifiable, interviews with Google Nest, ecobee, and Resideo point to anecdotal evidence that program administrators influenced the trajectory and, only marginally, the evolution of the optimization services. The timing for development and rollout into market for optimization services were likely not impacted by program administrators, with the exception of Google Nest, who noted they may not have released their service without program administrator support. Also indeterminate was whether the program administrator business model resulted in a lower maximum adoption level than would have resulted from a full native-model distribution of the service.

Recommendation: Energy Trust should consider claiming market transformation influence from their participation and support in this market. Our interviews provided evidence for the increased adoption in optimization services resulting from program administrator influence. The easy part of this effort has been verifying influence, the more challenging aspect remains: to translate the influence on adoption into a defensible quantifiable estimate of market transformation-based savings.

¹⁷ Savings persistence, with the potential for a multi-year stream of savings, extends the benefits of optimization services. See Navigant Consulting, March 2019, ComEd CY2018 Seasonal Savings Cooling Season Impact Evaluation Report, https://s3.amazonaws.com/ilsag/ComEd_CY2018_Nest_SS_Cooling_Season_Impact_Evaluation_Report_Draft_2018-03-13.pdf

Appendix A: List of Evaluation Reports

Apex Analytics, November 2017, Energy Trust of Oregon Nest Thermostat Seasonal Savings Pilot Evaluation, <https://www.energytrust.org/wp-content/uploads/2017/12/Energy-Trust-of-Oregon-Nest-Seasonal-Savers-Pilot-Evaluation-FINAL-wSR.pdf>

Apex Analytics, February 2020, Energy Trust of Oregon Resideo Thermostat Optimization Pilot, <https://www.energytrust.org/wp-content/uploads/2020/04/Energy-Trust-of-Oregon-Resideo-Pilot-Final-Report-wSR-Final.pdf>

EMI, April 2019, Thermostat Optimization Evaluation, <https://www.etcc-ca.com/reports/thermostat-optimization-evaluation>

Frontier Energy, July 2019, Evaluation, Measurement & Verification of CPS Energy's FY 2019 DSM Programs <https://www.sanantonio.gov/Portals/0/Files/Sustainability/STEP/CPS-FY2019.pdf>

MA DOER, July 2015, Nest Seasonal Savings Massachusetts Department of Energy Resources Impact Evaluation, <https://www.mcecleanenergy.org/wp-content/uploads/2016/08/MCE-AL-17-E-Seasonal-Savings-Pilot.pdf>

Navigant, May 2018, ComEd Seasonal Savings Impact Evaluation Report, https://s3.amazonaws.com/ilsag/ComEd_PY9_Nest_Seasonal_Savings_Impact_Evaluation_Report_Draft_2018-05-16.pdf

Navigant, February 2019, ComEd and Nicor Gas Connected Savings Heating Season Pilot Impact Evaluation Report, https://s3.amazonaws.com/ilsag/ComEd_and_Nicor_CY2018_Connected_Savings_Heating_Season_Impact_Eval_Report_Draft_2018-02-21.pdf