ADVANCED ENERGY CODES PROGRAM:

PROCESS EVALUATION PHASE II

Final

Prepared For:

New York State Energy Research and Development Authority (NYSERDA)
Albany, NY

Patricia Gonzales
NYSERDA Project Manager

Prepared By:

INDUSTRIAL ECONOMICS, INCORPORATED (IEc)

2067 Massachusetts Avenue
Cambridge, Massachusetts 02140
617/354-0074

Angela Vitulli, Project Manager

NYSERDA Contract 32883 May 2017

Notice

This report was prepared by Industrial Economics, Inc. in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority (hereafter "NYSERDA"). The opinions expressed in this report do not necessarily reflect those of NYSERDA or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, NYSERDA, the State of New York, and the contractor make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. NYSERDA, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

NYSERDA makes every effort to provide accurate information about copyright owners and related matters in the reports we publish. Contractors are responsible for determining and satisfying copyright or other use restrictions regarding the content of reports that they write, in compliance with NYSERDA's policies and federal law. If you are the copyright owner and believe a NYSERDA report has not properly attributed your work to you or has used it without permission, please email print@nyserda.ny.gov.

Table of Contents

List of Figures

List of Tables

1 Introduction

The Energy Conservation Construction Code of New York State (ECCCNYS, or the "Energy Code") is a minimum building standard for energy efficiency that applies to commercial and residential buildings across the State. To increase compliance with the Energy Code and to reduce the State's energy consumption, approximately 60 percent of which is attributable to buildings, the New York State Energy Research and Development Authority (NYSERDA) provides a range of training and support services through the Codes initiative of its Advanced Energy Codes and Standards program.[1] Most recently, the trainings focused on preparing municipal code officials, design professionals, and members of the construction trades for updates to the Energy Code that incorporated the 2015 International Energy Conservation Code (IECC) and ASHRAE 90.1-2013. These updates took effect in the State on October 3, 2016.[2]

NYSERDA contracted with multiple training contractors to develop and conduct a portfolio of approximately 16 training courses on the updates to the Energy Code, and dedicated $4 million of funding to support these trainings during the 2012 to 2016 period. The trainings targeted the three distinct audiences noted above and covered both commercial and residential buildings. NYSERDA also contracted with T.Y. Lin to provide support services to municipalities to help code officials better implement and comply with the Energy Code; these services include commercial and residential plan reviews, plan review presentations, on-site inspections, and an Energy Code hotline.

In 2016, IEc completed a Phase 1 process evaluation that focused on a pre- and post-training "knowledge" survey to analyze trainee learning and satisfaction. The primary goal of this Phase II process evaluation is to understand the contribution of NYSERDA training to behavioral changes among training participants that improve Energy Code compliance. A secondary goal is to evaluate the effectiveness of NYSERDA's Energy Code support services to municipalities. Evaluation objectives and methods are summarized in Table 1-1. Additional detail on methods is provided in Section 3.

[1] The Advanced Energy Codes and Standards program also contributes to the development of appliance and equipment standards through its Standards initiative. See: NYSERDA. Operating Plan for Technology and Market Development Programs (2012–2016). Second Revision, February 15, 2013.

[2] U.S. Department of Energy. "Building Energy Code Program: New York." Building Energy Codes Program. May 22, 2016. Accessed March 31, 2017, at: https://www.energycodes.gov/adoption/states/new-york.

Table 1-1. Summary of Objectives and Methods

Objective	Purpose	Method			
		Pre-/Post-Training Survey (Phase I)	Interviews with NYSERDA, Training Contractors (Phase I)	Behavioral Survey (Phase II)	Interviews with Municipalities Receiving Services (Phase II)
Evaluate trainees' reactions to the training program	Assess trainees' satisfaction with and the value of the training program	✓			
Measure the change in trainees' level of knowledge of the Energy Code following training	Assess training quality	✓	✓	✓	
Determine whether trainees plan to enact changes as a result of training	Assess the extent to which trainings may increase code compliance	✓	✓	✓	
Examine perceptions of training's effectiveness at increasing code compliance	Assess the extent to which trainings may increase code compliance, and inform improvements to NYSERDA's Energy Code initiative		✓	✓	
Solicit suggestions for other activities that trainees think would be effective at increasing code compliance	Inform improvements to NYSERDA's Energy Code initiative	✓	✓		
Evaluate municipalities' reactions to the services	Assess municipalities' satisfaction with and the value of the services				✓
Measure the change in municipalities' level of knowledge of the Energy Code following the services	Assess service quality				✓
Determine whether municipalities plan to enact changes as a result of the services	Assess the extent to which the services may increase code compliance				✓
Examine perceptions of service's effectiveness at increasing code compliance	Assess the extent to which services may increase code compliance, and inform improvements to NYSERDA's Energy Code initiative				✓

2 Results, Findings, and Recommendations

The following sections present the results, findings, and recommendations of this evaluation. First, Section 2.1 provides an overview of survey participation. Sections 2.2 through 2.4 discuss survey results for design professionals, and Sections 2.5 to 2.7 discuss survey results for code officials. Section 2.8 provides an overview of municipal support service interviewees, and Sections 2.9 to 2.11 discuss the results of the interviews. Section 2.12 presents other key findings beyond the original evaluation objectives. Finally, Section 2.13 summarizes findings and offers recommendations for NYSERDA to consider when developing or implementing future trainings and municipal support services.

2.1 Overview of Survey Participation

IEc conducted a web-based survey of design professionals and code officials to understand the contribution of NYSERDA training to behavioral changes among training participants that improve Energy Code compliance. IEc surveyed both training participants ("trainees") and a comparison group of non-participants ("non-trainees"). For both groups (design professionals and code officials), this evaluation compares both the differences within groups and between groups, where applicable. In other words, this evaluation examines the differences, if any, between trainees before and after training (within groups), *and* examines the differences, if any, between trainees and non-trainees (between groups). (See Methodology in Section 3 for more details).

For design professionals, IEc designed the sampling plan to meet NYSERDA's 90/10 standard for confidence and precision and produce statistically valid results, which allows for extrapolation of the survey results to the population. In other words, the results represent all New York design professionals, with 90 percent confidence. However, NYSERDA made the decision to limit the number of code officials included in the survey since it is thought that code officials, compared to design professionals, influence market change to a lesser degree. *Therefore, the results from the survey of code officials cannot be used to extrapolate to all code officials in New York.* In other words, the results presented for code officials represent the views and behaviors of those code officials who participated in the survey; they do not necessarily reflect the views and behaviors of all New York code officials. In addition, as with any survey, there is potential for self-selection bias in the respondents. In other words, respondents choosing to participate in the survey may be fundamentally different than those who do not choose to participate. Therefore, extrapolation and interpretation of evaluation results should be caveated with the consideration of potential bias in respondents.

It should also be noted that the ideal method for evaluating behavior changes is though direct observation of trainees after receiving training, or through direct review of outcomes associated with specific trainees (e.g., visiting a trainee building as part of a code compliance study). These approaches were not appropriate for this evaluation, given high costs and NYSERDA's indirect role in implementing code changes in the field. Therefore, IEc used the next-best approach of using a comparison group of non-participants to compare self-reported data.

Table 2-1 summarizes survey participation. As shown in the table, it was difficult to recruit design professionals to participate in the survey, especially those that had not participated in training; IEc had to send out 658 invitations, and achieved a seven percent response rate. Response rates for the other groups were higher, ranging from 21 percent to 31 percent.

Table 2-1. Overview of Survey Participation

Group	Invitations Sent	Completed Surveys	Response Rate
Design Professionals: Trainees	477	98	21%
Design Professionals: Non-trainees	658	44	7%
Code Officials: Trainees	77	23	30%
Code Officials: Non-trainees	39	12	31%

The survey instrument for design professionals included questions specific to residential and commercial buildings; therefore, IEc included questions to determine which types of buildings each respondent designs. Table 2-2 includes a summary of the responses to these questions. As shown in the table, the majority of respondents, across groups, design both residential and commercial structures.

Table 2-2. Design Professional Building Type Designed

Group	Building Type Designed	
	Residential	Commercial
Design Professionals: Trainees	67%	87%
Design Professionals: Non-trainees	80%	77%

The survey instrument for code officials included questions specific to plan reviews and inspections; therefore, IEc included questions to determine which of these activities each respondent works on. Table 2-3 includes a summary of the responses to these questions. Again, as shown in the table, the majority of code official respondents conduct both plan reviews and inspections.

Table 2-3. Code Official Work Conducted

Group	Work Conducted	
	Plan Reviews	Inspections
Code Officials: Trainees	74%	87%
Code Officials: Non-trainees	67%	83%

IEc identified "non-trainees" as individuals who did not take NYSERDA training on the 2016 Energy Code between April 2015 and June 2016. However, many other organizations offer Energy Code training, and IEc was unable to exclude individuals who received other training from the sample.[3] Therefore, the non-trainee survey instruments included a question asking respondents whether they had received formal training on the 2016 Energy Code. Responses to this question are provided in Table 2-4. Within code official "non-trainees," 83 percent reported participating in other relevant training. Code officials are required to take 24 hours of in-service training each calendar year,[4] so it is likely impossible

[3] In addition, other training providers may be conducted using NYSERDA developed materials.

[4] https://www.dos.ny.gov/dcea/edu_train_overview.html

to identify a counterfactual group that has not taken any training on the Energy Code. Therefore, this survey compares the effectiveness of NYSERDA training for code officials relative to other relative trainings, which is a higher bar for comparison than comparing trainees to a group that received no Energy Code training; hereafter, code official non-trainees are referred to as "non-participants" and trainees as "participants." Only 18 percent of design professionals took other Energy Code training during the year. Therefore, this study effectively compares behavior among those design professionals who participated in NYSERDA Energy Code training to those design professionals who received no Energy Code training.

Table 2-4. "Non-trainee" Participation in Other Relevant Training

Group	Participated in Other Relevant Training
Design Professionals: Non-trainees	18%
Code Officials: Non-trainees	83%

The survey also asked respondents what type of training they took and which organization provided the training. Most respondents who reported participating in other training indicated the training they took was in-person training. Code officials frequently mentioned training with New York State Building Officials Conference and New York State Division of Codes. Design professionals mentioned a variety of organizations including the American Institute of Architects and the New York City Department of Buildings.

2.2 Design Professionals: Trainee Learning and Level of Knowledge

Evaluation Questions: What did the trainees learn? What was their level of knowledge before and after the training?

To understand what trainees learned, three reported measures are compared for trainees before and after training, and between trainees and non-trainees:

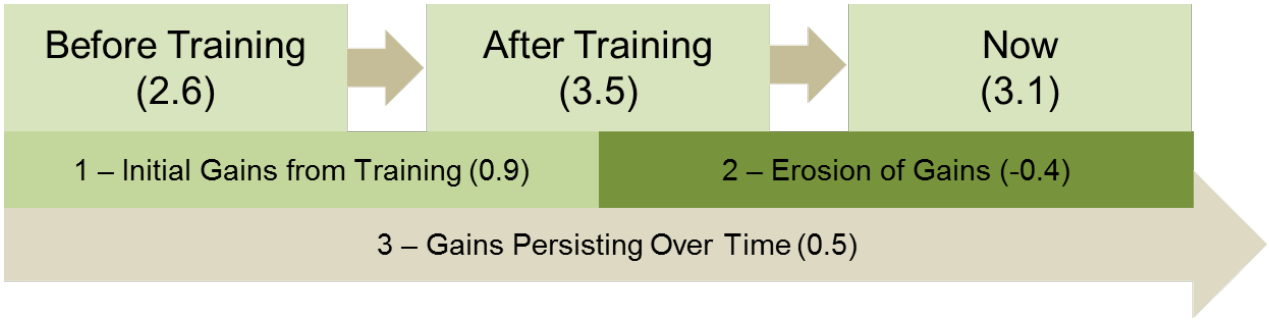
- Reported level of understanding,
- Confidence in applying the Energy Code, and
- Comfort in describing the Energy Code.

Overall, the findings for this question are mixed. It appears that trainees displayed a gain in understanding after taking the training; however, the gains eroded over time to some degree. In addition, comparing trainees (after completing training) to non-trainees reveals mixed results, although it is difficult to interpret study findings on this point with any degree of confidence due to the limitations of self-reported data. The difference between trainees and non-trainees with respect to understanding of the code overall is statistically significant; however, trainees' reported understanding of the code was lower than non-trainees, although the difference is substantively small. In addition, trainees report lower understanding of the residential and commercial updates to the Energy Code than non-trainees, but this difference is statistically insignificant and substantively small. Therefore, while it appears that trainees actually have lower understanding than non-trainees, the differences are small and in two cases, statistically insignificant (meaning we cannot be confident that the difference is in fact zero). Finally, there does not appear to be a difference between trainees and non-trainees with respect to their comfort

and confidence in applying the Energy Code. Specifically, the differences between trainees and non-trainees are not statistically significant, meaning that we cannot be confident that the differences are in fact zero. The differences observed are also substantively small (0.2 and 0.1 points, respectively), although those differences are negative, indicating that trainees have report lower confidence and comfort than non-trainees.

First, the knowledge survey in Phase I of the evaluation asked trainees how they would rate their understanding of the Energy Code, on a scale of one to five, where one is poor and five is excellent, both before and after they took the training. The behavior survey asked a similar question – to rate their understanding of the Energy Code overall, on a scale of one to five, where one is poor and five is excellent. Therefore, as depicted in Figure 2-1 there are three points in time that trainees' reported level of understanding is captured and compared: before training, directly after training, and some time after training (as captured in the behavior survey).

Figure 2-1. Design Professional Understanding of the Energy Code



Comparing level of understanding from these three points in time results in the following:

1. *Initial gains from training (0.9):* First, comparing the change from before training to directly after training reveals if the training raised respondents' level of understanding. There is a large, statistically significant increase in trainees' reported understanding immediately after training, as compared to directly before training. Respondents report about a one point higher rating on the scale of one to five (from 2.6 to 3.5) after training. This implies that respondents have absorbed the material presented in the training, and that their self-assessed level of understanding increased as a result of the training.
2. *Erosion of gains (-0.4):* Comparing the change from directly after training to now (the behavior survey) reveals if those gains in understanding persist over time. In other words, are trainees at the same level of understanding now that they reported directly after the training? There is a statistically significant difference between trainees' rating of their understanding directly after training and now (from 3.5 to 3.1); however, this difference is approximately a negative one half point (-0.4). This indicates that trainees' reported level of understanding now is less than it was directly after training. In other words, some of the gains observed before and after training are lost over time.[5] This finding is consistent with the body of literature on "training transfer," which indicates that persistence of knowledge gained during training, and ability to transfer training into the work context, is affected by several categories of factors including learner characteristics (e.g., cognitive ability, self-efficacy, pre-training motivation), intervention design (e.g., relative quality, content relevance, opportunities for

[5] All trainees participated in training between April 2015 and June 2016; the behavior survey was conducted in the fall/winter of 2016/2017.

practice) and work environment influences (e.g., supervisory support, peer support, and opportunity to perform skills gained during training).[6]

3. *Gains persisting over time (0.5):* Finally, IEc analyzed if respondents retain some of the gains in understanding, or do they return to their level of understanding *before* they took training? To examine this, the level of understanding now is compared to the level of understanding before training. While respondents lost some of the gains in understanding they reported directly after training, they do not return to their pre-training level of understanding. There is a statistically significant higher level of understanding reported by trainees in the behavior survey, as compared to before training, of one half point on the scale (from 2.6 to 3.1).

In addition to comparing trainees before and after training, comparing trainees to non-trainees reveals the potential effect of training; overall, the results are mixed. There is a statistically significant difference between trainees and non-trainees with respect to their understanding of the Energy Code overall, but trainees have a lower rating of their understanding than non-trainees (although the difference is only about one-third of a point on the rating scale). There is no statistically significant difference, and a difference of two tenths of a point less on the rating scale between trainees and non-trainees with respect to the rating of their understanding of the residential or commercial updates to the Energy Code (Table 2-5). In other words, while the differences between trainees and non-trainees with respect to their understanding of the updates are negative, they are not statistically significant, meaning that it is possible that the finding is due to chance.

Combined with the finding above that participants benefit from training in terms of increased knowledge, this suggests that design professionals signing up for training may have a lower baseline understanding of the Energy Code compared to non-participating design professionals, and therefore may have been more motivated to take the training course. This is a positive finding in that it suggests that the NYSERDA Energy Code training is "raising the floor" in terms of the understanding of the Energy Code among architects and other design professionals. However, another possible explanation is that design professionals who took the training are more familiar with all of the complexities of the Energy Code, while those who did not take the training believe they understand the Energy Code, but are not aware of the complexities that they are actually missing. This is a limitation of relying of self-reported data for evaluative purposes.

[6] Lisa A. Burke and Holly M. Hutchins, "Training Transfer: An Integrative Literature Review." *Human Resource Development Review*, Vol. 6, No. 3, Sept 2007, pages 263-296.

Table 2-5. Design Professional Understanding of the Energy Code

	Trainee Before (KS)[7]	Trainee After (KS)	Trainee After (BS)[8]	Trainee After (KS)/After (BS) Difference[9]	Trainee	Non-trainee	Trainee/ Non-trainee Difference
Energy Code overall	2.6 (n=94)	3.5[10] (n=89)	3.1 (n=94)	-0.4***	3.1 (n=94)	3.4 (n=43)	-0.3*
2016 Residential Energy Code updates	N/A	N/A	2.6 (n=85)	N/A	2.6 (n=85)	2.8 (n=41)	-0.2
2016 Commercial Energy Code updates	N/A	N/A	2.7 (n=93)	N/A	2.7 (n=93)	2.9 (n=39)	-0.2

Finally, the behavior survey asks both trainee and non-trainee respondents about their comfort and confidence levels in applying the Energy Code to their designs. First, respondents were asked to report how confident they are in applying the residential and commercial Energy Codes (asked separately) to their designs, on a scale of one to five, where one is not at all confident, and five is extremely confident. There is no statistically significant difference between trainees and non-trainees in their reported confidence in applying either Energy Code (residential or commercial) to their designs (Table 2-6). In fact, trainees report slightly *lower* confidence levels than non-trainees, although these differences are substantively small and statistically insignificant (meaning there is no statistical difference between the two). Specifically, trainees report 0.2 points lower on the rating scale for the residential Energy Code, and 0.1 points lower on the rating scale for the commercial Energy Code than non-trainees.

Table 2-6. Design Professional Confidence Applying the Energy Code

	Trainee	Non-trainee	Trainee/Non-trainee Difference
2016 Residential Energy Code	3.1 (n=85)	3.3 (n=42)	-0.2
2016 Commercial Energy Code	3.1 (n=91)	3.2 (n=39)	-0.1

Next, respondents were asked to assess whether or not they are comfortable describing how to comply with the residential and commercial Energy Code (asked separately) to one of their colleagues or business partners. Again, there is no statistically significant difference between trainees and non-trainees

[7] "KS" refers to the Knowledge Survey.

[8] "BS" refers to the Behavior Survey.

[9] For design professionals, all "Difference" columns denote the statistical significance of the differences reported. No stars mean the difference is not statistically significant; one star means the difference is statistically significant at the 10 percent level; two stars means the difference is statistically significant at the five percent level; three stars means the difference is statistically significant at the one percent level. Differences reported may not sum due to rounding.

[10] The difference between "Trainee After (KS)" and "Trainee Before (KS)" is 0.9***.

in the percent that reported they are comfortable describing either Energy Code (residential or commercial), meaning that statistically there is no difference between the two groups (Table 2-7). On average, trainees are *less* comfortable than non-trainees for the residential Energy Code (16 percent fewer trainees are comfortable). For the commercial Energy Code, there is a slight difference between trainees and non-trainees; one percent fewer trainees are comfortable. Similar to the question above, one potential explanation is that residential design professionals who seek out training are less confident about applying the Energy Code compared to those who do not seek out training. Again, non-trainees may have higher baseline knowledge of how to apply the Energy Code to residential designs compared to trainees. Or, there may be a disconnect between knowledge and confidence among non-trainees (i.e., non-trainees actually have a lower level knowledge but a higher level of confidence). Unfortunately, evaluation designs like this one that rely on self-reported data cannot discern if survey respondents misjudge their knowledge.

Table 2-7. Design Professional Comfort Describing How to Comply with the Energy Code

	Trainee	Non-trainee	Trainee/Non-trainee Difference
Comfort describing 2016 Residential Energy Code	48% (n=77)	64% (n=36)	-16%
Comfort describing 2016 Commercial Energy Code	53% (n=88)	54% (n=37)	-1%

2.3 Design Professionals: Trainees' Plans to Enact Changes

Evaluation Question: What changes do trainees plan to enact as a result of the training?

In order to assess the differences, if any, between what changes trainees intend to enact, and what changes they in fact made, as a result of the training, the surveys asked respondents to report the impact of training. Specifically, in both the behavior and knowledge surveys, trainees were asked if:

- They intend to/have applied much of the training content to their job;
- The training will help/has helped them do their job better; and,
- They plan to/have changed some aspects of their work to apply the training.

Both sets of questions were asked on a five point scale, where one was strongly disagree, and five was strongly agree. Note that actual behavior changes are examined in depth in Section 2.4.

When comparing the results of these two questions between surveys, there is a statistically significant drop of nearly one point in the agreement rating from the knowledge survey to the behavioral survey for all three questions (Table 2-8). In other words, trainees agree *less* with those statements than they did closer to the time they received training. This suggests that participants' intentions directly after training were more ambitious than their behavior in practice; this is a common finding among interventions that seek behavior change.

Table 2-8. Design Professionals' Plans to Enact Changes

	Trainee (KS)	Trainee (BS)	Trainee KS/BS Difference
Apply training content to job	4.3 (n=94)	3.3 (n=94)	-1.0***
Training helped do job better	4.3 (n=95)	3.4 (n=95)	-0.8***
Changed aspects of work to apply training	4.0 (n=94)	3.2 (n=94)	-0.8***

The behavior survey also asked all respondents to summarize the most significant changes they have made to their designs related to the 2016 Energy Code. For design professionals, the most common types of changes reported were insulation, lighting, and documentation. More non-trainees reported changes to lighting than trainees. Additional detail on the responses to this question can be found in Appendix C.

2.4 Design Professionals: Trainees' Behavior Compared to Non-trainees

Evaluation Question: Does evidence exist that participants in NYSERDA's Energy Code training demonstrate preferable behaviors in implementing and/or enforcing the Energy Code, relative to non-participants?

There are several ways to examine whether or not trainees demonstrate preferable behaviors in implementing the Energy Code, relative to non-trainees. The behavior survey provides two ways to examine these differences, comparing trainees' responses before and after training, and comparing responses between trainees and non-trainees. In other words, (1) do trainees report differences in their behaviors after they received training? and (2) do trainees report different behaviors than non-trainees? The behavior survey asked respondents about several aspects of implementation of the Energy Code, including: incorporating provisions into residential and commercial building designs, percentages above code minimums achieved by projects, communications with contractors, and use of different compliance paths. Overall, the findings for the impact of training on reported implementation of these residential and commercial behaviors is mixed. [11]

Incorporating provisions into residential and commercial building designs. Both trainees and non-trainees were asked if they incorporate the provisions in Table 2-9 into their residential and commercial building designs, as applicable. Trainees were asked to further refine their response by stating, if they do incorporate the provision, whether they incorporated it before or after training.

[11] Note that this analysis does not address causality; in other words, evidence of what *caused* observed changes is not discussed. The results display where there are statistically significant differences between the groups only.

Table 2-9. Commercial and Residential Provisions Included in Survey

Provision	Residential	Commercial
A continuous air barrier shall be provided throughout the building thermal envelope. Breaks or joints in the air barrier shall be sealed.	X	X
2016 Energy Code-required levels of ductwork and piping insulation.	X	X
All recessed luminaires installed in the building thermal envelope shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s). All recessed luminaires shall be sealed with a gasket or caulk.	X	X
Proper class of vapor retarders provided in interior side of frame walls (except zone 4).	X	
Not using building cavities as ducts or plenums, including as returns.	X	
Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.	X	
Ventilation shall be provided that meets the International Residential Code or International Mechanical Code, or other approved means of ventilation. Outdoor air intakes and exhausts shall have dampers that close when the system is not operating.	X	
Day-lit spaces (where vertical fenestration area is 30-40% of the gross above-grade wall area or skylight area is 3-5% of the gross roof area) have separate controls from general lighting controls or are automatically controlled with daylight sensors.		X
Each cooling systems shall include either an air or water economizer.		X
Ventilation, either natural or mechanical, shall be provided in accordance with Ch. 4 of the International Mechanical Code. Mechanical ventilation shall provide the capability to reduce the outdoor air supply to the minimum required by Ch. 4 of the IMC.		X

There are statistically significant gains in trainees who reported implementation before and after training. A higher percentage of trainees report implementing all of the residential and commercial provisions after training than before training; all of these differences are statistically significant.

The findings comparing trainees to non-trainees are mixed (Table 2-10 and Table 2-11). When comparing trainees to non-trainees for residential provisions, some evidence exists that trainees apply the provisions more often than non-trainees. All of the provisions are applied more often by trainees than non-trainees, except one. Six percent fewer trainees incorporate the provision that buildings are provided with ventilation that meets International Residential or Mechanical Code requirements for ventilation; although the difference is not statistically significant (Table 2-10). For the other provisions, only two of the provisions are applied more often with a statistically significant difference – sizing of heating and cooling equipment, and not using building cavities as ducts or plenums.[12]

When comparing trainees to non-trainees for commercial provisions, there is mixed evidence of the effect of training on application of the provisions (Table 2-11). For the provision requiring each cooling system to include an air or water economizer, the difference between trainees and non-trainees is positive and statistically significant (20 percent higher for trainees). For the following provisions, while there is a

[12] This provision is new to the code that took effect October 3, 2016.

higher rate of trainees applying the provision than non-trainees, the difference is not statistically significant: continuous air barrier, code-required levels of ductwork, and IC-rated recessed luminaries. Finally, for the provisions requiring day-lit spaces have separate controls and code-minimum ventilation, the differences between trainees and non-trainees are in fact negative, although these differences are not statistically significant.

IEc consulted experts and trainers for potential explanations as to why the economizer provision was the only commercial provision with a significant difference between trainees and non-trainees (20 percent higher). One of the trainers noted that the training specifically emphasized this provision, as it had been requested by numerous trainees. Additionally, this trainer pointed out that many architects do not know what economizers are before training. Also, an additional expert noted that the provision for economizers in the prior version of the Energy Code (the 2012 IECC) was confusing, and is much clearer in the current version of the code; this may have led to an increase in understanding of when economizers are required, and subsequently increased the implementation of this provision.

Percentage above code minimums achieved by projects. For survey respondents that reported using compliance software, IEc asked trainees what percentage above code minimums their projects typically showed before and after training; non-trainees were asked what percentage above code minimums their projects typically show. Trainees indicated that their design projects achieve a statistically significantly higher percentage of above code minimums after training (1.3 percent higher); however, the difference between the percentage above code minimums for trainees and non-trainees is not statistically significant (0.3 percent higher). It should be noted that the NYSERDA training program is not designed to lead to above code results. However, in practice, it is rare for individual projects to come in right on the compliance line; projects that comply with code are typically above code by varying degrees.

Communications with contractors. The survey asked about how trainees and non-trainees communicate with their contractors, on both residential and commercial buildings (asked separately). Specifically, they were asked on a scale of one to five, where one is never and five is always, how often they communicate with contractors to ensure that vapor retarders, continuous air barriers, and envelope insulation are installed properly when working on residential and commercial buildings. Trainees were also asked to report the frequency of their communications before and after training. The difference between the rate of communication with contractors for residential and commercial buildings before and after training is statistically significant and positive; however, the difference between trainees and non-trainees is not statistically significant. In fact, trainees report communicating less than non-trainees (0.1 point difference on the rating scale) for commercial buildings.

Table 2-10. Design Professional Implementation of Residential Provisions

Measure	Trainee Before	Trainee After	Trainee Before/After Difference	Trainee	Non-trainee	Trainee/ Non-trainee Difference
A continuous air barrier shall be provided throughout the building thermal envelope. Breaks or joints in the air barrier shall be sealed.	56% (n=43)	93% (n=43)	+37%***	93% (n=43)	85% (n=33)	+8%
2016 Energy Code-required levels of ductwork and piping insulation	38% (n=42)	71% (n=42)	+33%***	71% (n=42)	59% (n=32)	+12%
All recessed luminaires installed in the building thermal envelope shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.	38% (n=45)	76% (n=45)	+38%***	76% (n=45)	71% (n=31)	+5%
Proper class of vapor retarders provided in interior side of frame walls (except zone 4)	53% (n=40)	83% (n=40)	+30%***	83% (n=40)	77% (n=30)	+6%
Not using building cavities as ducts or plenums, including as returns	56% (n=43)	77% (n=43)	+21%**	77% (n=43)	55% (n=29)	+22%*
Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.	36% (n=44)	64% (n=44)	+27%**	64% (n=44)	28% (n=29)	+36%***
The building shall be provided with ventilation that meets the requirements of the International Residential Code or International Mechanical Code, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.	35% (n=43)	67% (n=43)	+33%***	67% (n=43)	73% (n=30)	-6%

For the each of the above residential provisions, Trainee respondents were asked to choose one of the following options: "Yes – incorporated before training", "Yes – began incorporating after training", "No – do not incorporate", "No – provision is the responsibility of a separate entity", "Don't know", and "N/A". The Trainee Before *measure was calculated from the number of respondents who selected "Yes – incorporated before training" divided by the total number of respondents of that question who neither selected "Don't know", "N/A", or skipped the question.*

The Trainee After *measure was calculated from the combined number of respondents who selected "Yes – incorporated before training", and "Yes – began incorporating after training", divided by the total number of respondents of that question who neither selected "Don't know", "N/A", or skipped the question.*

Table 2-11. Design Professional Implementation of Commercial Provisions

Measure	Trainee Before	Trainee After	Trainee Before/After Difference	Trainee	Non-trainee	Trainee/ Non-trainee Difference
A continuous air barrier shall be provided throughout the building thermal envelope. Breaks or joints in the air barrier shall be sealed.	58% (n=57)	89% (n=57)	+32%***	89% (n=57)	80% (n=30)	+9%
2016 Energy Code-required levels of ductwork and piping insulation	31% (n=59)	66% (n=59)	+36%***	66% (n=59)	57% (n=28)	+9%
All recessed luminaires installed in the building thermal envelope shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.	28% (n=54)	65% (n=54)	+37%***	65% (n=54)	64% (n=28)	+1%
Day-lit spaces (where vertical fenestration area is 30 to 40 percent of the gross above-grade wall area or where skylight area is 3 to 5 percent of the gross roof area) have separate controls from general lighting controls or are automatically controlled with daylight sensors	24% (n=51)	62% (n=51)	+39%***	63% (n=51)	63% (n=30)	-1%
Each cooling system shall include either an air or water economizer.	24% (n=54)	56% (n=54)	+31%***	56% (n=54)	36% (n=28)	+20%*
Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the International Mechanical Code. Where mechanical ventilation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the International Mechanical Code.	24% (n=58)	59% (n=58)	+34%***	59% (n=58)	62% (n=29)	-3%

For the each of the above commercial provisions, Trainee respondents were asked to choose one of the following options: "Yes – incorporated before training", "Yes – began incorporating after training", "No – do not incorporate", "No – provision is the responsibility of a separate entity", "Don't know", and "N/A". The Trainee Before *measure was calculated from the number of respondents who selected "Yes – incorporated before training" divided by the total number of respondents of that question who neither selected "Don't know", "N/A", or skipped the question.*

The Trainee After *measure was calculated from the combined number of respondents who selected "Yes – incorporated before training", and "Yes – began incorporating after training", divided by the total number of respondents of that question who neither selected "Don't know", "N/A", or skipped the question.*

Though there is a small, statistically insignificant difference, IEc consulted experts and trainers for potential explanations as to why trainees may report communicating less with contractors for commercial buildings than non-trainees. One trainer noted that communication is a focus of the training, and could not identify a reason for this difference. However, one of the experts noted that design professionals are often not involved in building construction after they complete their designs due to the nature of their contracts, and thus responses to this question likely vary by design-build companies (more communication) versus design only companies (less communication). It is possible that more of the trainees work for design only companies as opposed to design-build companies.

Use of different compliance paths. Both trainees and non-trainees were asked since the implementation of the 2016 Energy Code, if they have started using different compliance paths from the path(s) they used to use. A statistically significantly higher percentage of trainees than non-trainees report started to use different compliance paths since the implementation of the 2016 Energy Code (15 percent higher for trainees). This finding indicates how design professionals interact with the Energy Code changes after training. The survey asked respondents to explain their response to this question, but few respondents provided an explanation detailing the compliance paths they have started to use.

2.5 Code Officials: Participant Learning and Level of Knowledge

Evaluation Questions: What did the participants learn? What was their level of knowledge before and after the training?

As noted in Section 2.1, NYSERDA made the decision to limit the number of code officials included in the behavior survey based on the extent to which code officials, compared to design officials, can influence market change. The study included a sample of 40 code officials who have participated in NYSERDA training ("participants"), and 40 code officials who did not participate in NYSERDA training ("non-participants"). [13] As a reminder, the majority of the non-participants in the survey participated in other, non-NYSERDA training; therefore, this survey compares the effectiveness of NYSERDA training for code officials relative to other trainings. As the study design did not have a statistically valid sample for code officials, the results discussed in this and the next two sections cannot be used to extrapolate to all code officials in New York State. In other words, the results represent the views and behaviors of those code officials who participated in the survey; they do not necessarily reflect the views and behaviors of all New York code officials.

To understand what participants learned, three reported measures are compared for participants before and after training, and between participants and non-participants:

- Reported level of understanding,
- Confidence in applying the Energy Code, and
- Comfort in describing the Energy Code.

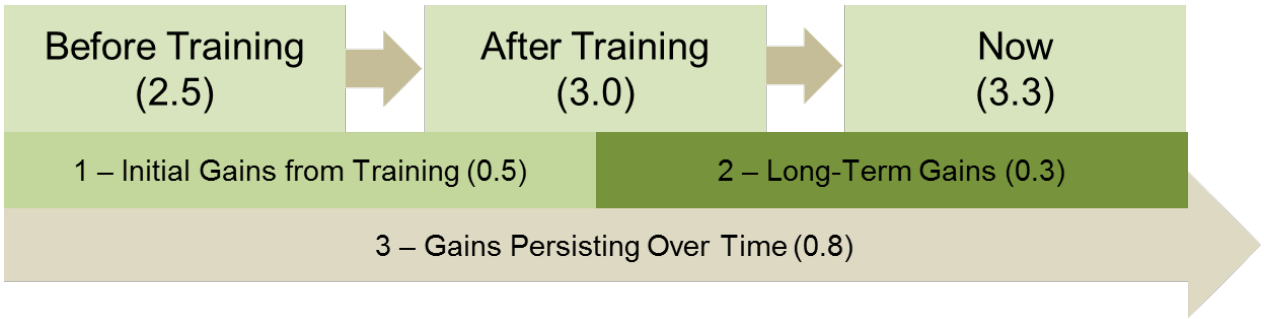
Overall, the findings for this question are largely positive. There are increases in participant reported levels of understanding directly after training that persist beyond training. Participants report a greater

[13] The initial sample of 40 non-participant code officials was increased to 80 code officials to adjust for lower than expected response rate among the non-participants.

overall understanding than non-participants, and participants report higher levels of confidence and comfort in applying the Energy Code to their work.

First, the knowledge survey in Phase I of the evaluation asked participants how they would rate their understanding of the Energy Code, on a scale of one to five, where one is poor and five is excellent, both before and after they took the training. The behavior survey asked a similar question – to rate their understanding of the Energy Code overall, on a scale of one to five, where one is poor and five is excellent. Therefore, as depicted in Figure 2-2 there are three points in time that participants' reported level of understanding is captured: before training, directly after training, and some time after training (as captured in the behavior survey).

Figure 2-2. Code Official Understanding of the Energy Code



Comparing level of understanding from these three points in time results in the following:

1. *Initial gains from training (0.5):* First, comparing the change from before training to directly after training reveals if the training raised respondents' level of understanding. There is an increase in participants' reported understanding immediately after training, as compared to directly before training. Respondents report an increase from 2.5 to 3.0 (0.5 points higher on the rating scale) after training. This implies that participants have absorbed the material presented in the training, and that their self-assessed level of understanding increased as a result of the training.
2. *Long-term gains (0.3)*: Comparing the change from directly after training to now (the behavior survey) reveals if those gains in understanding persist over time. In other words, are participants at the same level of understanding now that they reported directly after the training? For code officials, it appears that the increase in understanding achieved directly after training persists beyond training. In fact, comparing their reported level of understanding after training to their level of understanding now shows an increase of 0.3 points on the rating scale (from 3.0 to 3.3). The body of literature on "training transfer," which indicates that persistence of knowledge gained during training, and ability to transfer training into the work context, is affected by several categories of factors, including learner characteristics (e.g., cognitive ability, self-efficacy, pre-training motivation), intervention design (e.g., relative quality, content relevance, opportunities for practice), and work environment influences (e.g., supervisory support, peer support, and opportunity to perform skills gained during training).[14]
3. *Gains persisting over time (0.8):* Finally, IEc analyzed if respondents retain some of the gains in understanding, or do they return to their level of understanding *before* they took training? To examine this, the level of understanding now is compared to the level of understanding before training. The

[14] Lisa A. Burke and Holly M. Hutchins, "Training Transfer: An Integrative Literature Review." *Human Resource Development Review*, Vol. 6, No. 3, Sept 2007, pages 263-296.

largest difference observed is for this measure - comparing the level of understanding that participants report before training to their level of understanding as reported in the behavior survey. There is an increase in level of understanding reported by participants in the behavior survey, as compared to before training, of 0.8 points on the scale (from 2.5 to 3.3).

Comparing participants to non-participants, participants report having a greater overall understanding than non-participants of the 2016 Energy Code. There is a positive difference between participants and non-participants with respect to their understanding of the Energy Code overall (0.3 points higher on the rating scale – from 3.0 to 3.3). There is also a positive difference between participants' and non-participants' reported understanding of the 2016 updates to the Energy Code (0.4 points higher on the rating scale – from 2.7 to 3.1). For code officials, it appears that training has a significant impact on participants, both when looking at participants before and after training, and when looking at participants versus non-participants. This implies that the training is more applicable across code officials; in other words, that the consistent gains in understanding imply that all code officials could benefit from NYSERDA's Energy Code training. It is important to note again that these are self-reported levels of understanding; the conclusions assume that respondents are accurately reporting their level of understanding.

Table 2-12. Code Official Understanding of the Energy Code

	Participant Before (KS)	Participant After (KS)	Participant After (BS)	Participant After (KS)/After (BS) Difference	Participant	Non-participant	Participant/ Non-participant Difference
Energy Code overall	2.5 (n=20)	3.0 (n=20)	3.3 (n=20)	+0.3	3.3 (n=20)	3.0 (n=12)	+0.3
2016 Com-mercial Energy Code update	N/A	N/A	3.1 (n=23)	N/A	3.1 (n=23)	2.7 (n=12)	+0.4

Finally, the behavior survey asked both participant and non- participant respondents about their comfort and confidence levels in applying the Energy Code to their work. First, respondents were asked to rate their level of confidence in enforcing the 2016 commercial Energy Code, on a scale of one to five, where one is not at all confident, and five is extremely confident. There was essentially no difference between participants and non-participants in their reported confidence in enforcing the Energy Code; participants report an average 0.1 points higher on the rating scale (from 3.3 to 3.4) (Table 2-13). Next, respondents were asked if they would feel comfortable describing how to comply with the 2016 commercial Energy Code to one of their colleagues or others in the design and construction communities (Table 2-14). Here, there is a substantial difference between participants and non-participants in the percent that reported they are comfortable describing how to comply with the Energy Code; 23 percent more participants feel comfortable than non-participants (65 percent versus 42 percent).

Table 2-13. Code Official Confidence Applying the Energy Code

	Participant	Non-participant	Participant/ Non-participant Difference
Confidence enforcing 2016 Commercial Energy Code	3.4 (n=23)	3.3 (n=12)	+0.1

Table 2-14. Code Official Comfort Describing How to Comply with the Energy Code

	Participant	Non-participant	Participant/ Non-participant Difference
Comfortable describing how to comply with 2016 Commercial Energy Code	65% (n=23)	42% (n=12)	+23%

2.6 Code Officials: Participants' Plans to Enact Changes

Evaluation Question: What changes do participants plan to enact as a result of the training?

To assess the differences, if any, between changes that participants intended to enact after training, and changes they in fact made, the knowledge and behavior surveys asked respondents if:

- They intend to/have applied much of the training content to their job,
- The training will help/has helped them do their job better, and
- They plan to/have changed some aspects of their work to apply the training.

Both sets of questions were asked on a five point scale, where one was strongly disagree, and five was strongly agree. Note that actual behavior changes are examined in depth in Section 2.7.

When comparing the results of these two questions between surveys, there is a small drop in the agreement ratings from the knowledge survey to the behavioral survey. In other words, participants agree *less* with those statements than they did closer to the time they received training; however, the differences (particularly for the first two questions) indicates the responses are essentially the same (Table 2-15). This suggests that participants' intentions directly after training were more ambitious than what they ultimately did in practice; this is a common finding among interventions that seek behavior change.

Table 2-15. Code Officials' Plans to Enact Changes

	Participant (KS)	Participant (BS)	Participant KS/BS Difference
Apply training content to job	3.7	3.5	-0.2
Training helped do job better	3.9	3.7	-0.2
Changed aspects of work to apply training	3.8	3.4	-0.4

The behavior survey asked all respondents to summarize the most significant changes they have made to their plan reviews or building inspections related to the 2016 Energy Code. Very few code officials reported making significant changes, but of those that did, the most common types of changes were

insulation, lighting, and blower door testing. There are no major differences between the changes reported by participants versus non-participants. Additional detail on the responses to this question can be found in Appendix C.

2.7 Code Officials: Participants' Behavior Compared to Non-participants

Evaluation Question: Does evidence exist that participants in NYSERDA's Energy Code training demonstrate preferable behaviors in implementing and/or enforcing the Energy Code, relative to non-participants?

There are several ways to examine whether or not participants demonstrate preferable behaviors in enforcing the Energy Code, relative to non-participants. The behavior survey provides two ways to examine the differences between participants' and non-participants' reported enforcement of the Energy Code: comparing participants' responses before and after training, and comparing responses between participants and non-participants. The behavior survey asks respondents about several aspects of enforcing the Energy Code, including: checking for provisions in commercial building plan reviews and inspections, and conducting prescribed inspection practices.

Checking for provisions in commercial building plan reviews and inspections. Both participants and non-participants were asked if they check for the provisions in Table 2-16 in their commercial building plan reviews and commercial building inspections. Participants were asked to further refine their response by stating, if they do check for the provision, whether they checked it before or after training.

Table 2-16. Commercial Provisions Included in Survey

Provision
A continuous air barrier shall be provided throughout the building thermal envelope. Breaks or joints in the air barrier shall be sealed.
2016 Energy Code-required levels of ductwork and piping insulation.
All recessed luminaires installed in the building thermal envelope shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s). All recessed luminaires shall be sealed with a gasket or caulk.
Day-lit spaces (where vertical fenestration area is 30-40% of the gross above-grade wall area or skylight area is 3-5% of the gross roof area) have separate controls from general lighting controls or are automatically controlled with daylight sensors.
2016 Energy Code-required space-specific lighting power density (LPD).
Each cooling systems shall include either an air or water economizer.
Ventilation, either natural or mechanical, shall be provided in accordance with Ch. 4 of the International Mechanical Code. Mechanical ventilation shall provide the capability to reduce the outdoor air supply to the minimum required by Ch. 4 of the IMC.

Overall, the findings for the impact of training on reported implementation of these provisions is positive. In building plan reviews, all participants check for the included provisions more often than they did before training (Table 2-17), by substantial margins. For example, 57 percent more participants check for 2016 Energy Code-required space-specific lighting power density after training, and 50 percent more participants check for continuous air barriers after training.

In building inspections, all participants check for the included provisions more often than they did before training (Table 2-18). Similar to building plan reviews, a substantially higher percentage of participants report checking for these provisions after training. For example, 57 percent more participants report checking for separate controls for day-lit spaces and 2016 Energy Code-required space-specific lighting power density than before training.

When comparing participants to non-participants, for both plan reviews and building inspections, more participants report checking for the included provisions than non-participants with two exceptions. Participants check for air or water economizers in cooling systems and proper ventilation *less* than non-participants. IEc consulted experts and trainers for potential explanations for these results. One expert noted that after training, code officials may think that other entities are responsible for ensuring these provisions are met, or they may realize that these provisions are difficult to verify. Another expert mentioned that the non-trainee group may have had a higher baseline understanding of the Energy Code, which could be related to the progressiveness of their jurisdiction or because jurisdictions often send junior staff to training. For the ventilation provision in particular, one trainer noted that ventilation can be hard to understand in relation to the building's energy use and that code officials may rely on the engineers to meet the provision, especially since code officials have limited time to conduct their inspections. However, this trainer also noted that code officials should be able to quickly check the ventilation controls.

Conducting prescribed inspection practices. Participants and non-participants were asked how often they do the following, on a scale of one to five, where one is never, and five is always:

- Check to ensure that continuous air barriers are installed properly;
- Check to ensure envelope insulation is installed properly; and
- Require blower door testing (for buildings less than 50,000 square feet).

Participants were also asked how often they conduct these inspection practices before and after training. Overall, more participants conduct the prescribed inspection practices after training than before training (Table 2-19). The difference between participants and non-participants rate of conducting prescribed inspection practices is mixed. More participants check for continuous air barriers (0.8 point higher on the rating scale) and envelope insulation (0.5 point higher on the rating scale). However, participants report a two point lower rating than non-participants for requiring blower door testing. It is important to note that the code officials do not conduct blower door testing; the building contractor or owner hires a third party to do this. The code official should then check that the blower door testing was done. IEc consulted experts and trainers for potential explanations for why code official trainees may require the testing less frequently than non-trainees. One trainer noted that it varies by jurisdiction as to whether the contractor or owner is required to provide the testing results to the code official. Additionally, some jurisdictions may not be familiar with blower door testing in commercial buildings and therefore do not require it.

Table 2-17. Code Official Incorporation of Commercial Provisions in Building Plan Reviews

Measure	Participant Before	Participant After	Participant Before/ After Difference	Participant	Non-participant	Participant/ Non-participant Difference
A continuous air barrier shall be provided throughout the building thermal envelope. Breaks or joints in the air barrier shall be sealed.	44% (n=16)	94% (n=16)	+50%	94% (n=16)	63% (n=8)	+31%
2016 Energy Code-required levels of ductwork and piping insulation	67% (n=15)	87% (n=15)	+20%	87% (n=15)	75% (n=8)	+12%
All recessed luminaires installed in the building thermal envelope shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.	36% (n=14)	79% (n=14)	+43%	79% (n=14)	50% (n=8)	+29%
Day-lit spaces (where vertical fenestration area is 30 to 40 percent of the gross above-grade wall area or where skylight area is 3 to 5 percent of the gross roof area) have separate controls from general lighting controls or are automatically controlled with daylight sensors	17% (n=12)	67% (n=12)	+50%	67% (n=12)	63% (n=8)	+4%
2016 Energy Code-required space-specific lighting power density (LPD)	14% (n=14)	71% (n=14)	+57%	71% (n=14)	43% (n=7)	+28%
Each cooling system shall include either an air or water economizer.	21% (n=14)	57% (n=14)	+36%	57% (n=14)	71% (n=7)	-14%
Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the International Mechanical Code. Where mechanical ventilation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the International Mechanical Code.	33% (n=15)	73% (n=15)	+40%	73% (n=15)	75% (n=8)	-2%

For the each of the above plan review provisions, Participant respondents were asked to choose one of the following options: "Yes – incorporated before training", "Yes – began incorporating after training", "No – do not incorporate", "No – provision is the responsibility of a separate entity", "Don't know", and "N/A". The Participant Before *measure was calculated from the number of respondents who selected "Yes – incorporated before training", divided by the total number of respondents of that question who neither selected "Don't know", "N/A", or skipped the question.*

The Participant After *measure was calculated from the combined number of respondents who selected "Yes – incorporated before training", and "Yes – began incorporating after training", divided by the total number of respondents of that question who neither selected "Don't know", "N/A", or skipped the question.*

Table 2-18. Code Official Incorporation of Commercial Provisions in Inspections

Measure	Participant Before	Participant After	Participant Before/After Difference	Participant	Non-participant	Participant/ Non-participant Difference
A continuous air barrier shall be provided throughout the building thermal envelope. Breaks or joints in the air barrier shall be sealed.	44% (n=16)	88% (n=16)	+44%	88% (n=16)	63% (n=8)	+25%
2016 Energy Code-required levels of ductwork and piping insulation	50% (n=16)	88% (n=16)	+38%	88% (n=16)	75% (n=8)	+13%
All recessed luminaires installed in the building thermal envelope shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.	27% (n=15)	80% (n=15)	+53%	80% (n=15)	57% (n=7)	+23%
Day-lit spaces (where vertical fenestration area is 30 to 40 percent of the gross above-grade wall area or where skylight area is 3 to 5 percent of the gross roof area) have separate controls from general lighting controls or are automatically controlled with daylight sensors	7% (n=14)	64% (n=14)	+57%	64% (n=14)	63% (n=8)	+1%
2016 Energy Code-required space-specific lighting power density (LPD)	7% (n=14)	64% (n=14)	+57%	64% (n=14)	57% (n=7)	+7%
Each cooling system shall include either an air or water economizer.	13% (n=15)	53% (n=15)	+40%	53% (n=15)	71% (n=7)	-18%
Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the International Mechanical Code. Where mechanical ventilation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the International Mechanical Code.	25% (n=16)	63% (n=16)	+38%	63% (n=16)	75% (n=8)	-12%

For the each of the above inspection provisions, Participant respondents were asked to choose one of the following options: "Yes – incorporated before training", "Yes – began incorporating after training", "No – do not incorporate", "No – provision is the responsibility of a separate entity", "Don't know", and "N/A". The Participant Before *measure was calculated from the number of respondents who selected "Yes – incorporated before training", divided by the total number of respondents of that question who neither selected "Don't know", "N/A", or skipped the question.*

The Participant After *measure was calculated from the combined number of respondents who selected "Yes – incorporated before training", and "Yes – began incorporating after training", divided by the total number of respondents of that question who neither selected "Don't know", "N/A", or skipped the question.*

Table 2-19. Code Official Commercial Inspection Practices

	Participant Before	Participant After	Participant Before/After Difference	Participant	Non-participant	Participant/ Non-participant Difference
Air barriers	3.7 (n=19)	4.3 (n=19)	+0.6	4.4 (n=19)	3.6 (n=10)	+0.8
Envelope insulation	4.3 (n=19)	4.9 (n=19)	+0.6	4.9 (n=19)	4.4 (n=10)	+0.5
Blower door testing (for buildings less than 50,000 square feet)	2.0 (n=19)	2.7 (n=19)	+0.7	2.7 (n=19)	4.7 (n=10)	-2.0

2.8 Overview of Municipal Support Services Interviewees

IEc interviewed 10 municipal staff, representing 10 different local governments, who received plan review and/or inspection services from T.Y. Lin between late 2015 and early 2017. All of the interviewees received the plan review services, ranging from one to about twenty instances; less than half (four) received the inspection services, ranging from one to eight instances. They all received training on the Energy Code, and all work on both residential and commercial buildings.[15]

2.9 Municipal Support: Reactions and Satisfaction

Evaluation Questions: How did municipalities react to the services? How satisfied are municipalities with the services provided?

IEc asked interviewees about why they pursued the plan review and inspection services (where applicable) and whether the services met their needs. Interviewees reported a few primary reasons for pursuing the services, and that overall, the services met their needs. The most common reasons are listed below, with the number of interviewees who reported the reason in parentheses; interviewees often reported more than one reason, and therefore the total number listed is greater than the total number of interviewees (10).

- To learn more about the code (5 interviewees).
- To save time and/or resources (4 interviewees).
- Because the services are free (2 interviewees).
- To meet the requirements of the Clean Energy Communities program (2 interviewees).
- Third party review (2 interviewees).
    - To provide expert review, which is helpful in discussions with architects/designers who initially do not accept requirements. Three other interviewees mentioned in their responses

[15] Most (eight out of 10) of the interviewees are code officials. One interviewee is a fire marshal and rarely conducts Energy Code reviews, and another is a director of planning. IEc attempted to include only code officials in the interviews, but included other municipal staff due to a lower than expected response rate.

to other questions that having third party review is useful when getting pushback from architects/designers.

- To provide a secondary review.

Interviewees also reported high rates of satisfaction with municipal services. IEc asked interviewees to rate their satisfaction with a variety of program elements on a scale of one to five with one being very dissatisfied, and five being very satisfied. Most interviewees (9 out of 10) rated their satisfaction with all elements of the services as somewhat satisfied or very satisfied. None of the interviewees reported a dissatisfaction rating of one (very dissatisfied) or two (somewhat dissatisfied). A summary of responses to these questions, including mean, median, and mode, is included in Table 2-20. All 10 interviewees provided a rating for each of the program elements with the exception of "sufficiency of the resolution of any issues," for which four interviewees responded that the question was not applicable as they had not experienced any issues.

Table 2-20. Summary of Satisfaction Scores by Program Element

Program Element	Count	Mean	Median	Mode
Ease of enrollment	10	4.8	5	5
Quality of T.Y. Lin's performance	10	4.7	5	5
Timeliness of service	10	4.7	5	5
Clarity of communication from T.Y. Lin	10	4.8	5	5
Comprehensiveness of T.Y. Lin staff knowledge	10	4.7	5	5
Sufficiency of the resolution of any issues	6	4.7	5	5
Overall satisfaction with the services	10	4.9	5	5

All municipal interviewees reported that they would recommend the services to a colleague; in fact, some of the interviewees had already done so. All interviewees also reported that they would use the plan review services again in the future, and most (8 out of 10) reported that they would also use the inspection services. One of the interviewees caveated they would only use the services again if they were free.[16]

Interviewees did note a few barriers to using the inspection services:

- Two interviewees noted that they often only have 24 hours of notice before an inspection, and therefore are not able to coordinate the services with T.Y. Lin.
- One interviewee reported that s/he wants to use the plan review services again, but would have to do so behind the scenes because their town planning board does not approve of the use of third parties. This interviewee cannot use the inspection services because the town does not approve of them.
- One interviewee reported that they had not yet used the inspection services because they do not know what to expect, and remarked that some people who have used the service felt they were

[16] This interviewee received the services as part of the Clean Energy Communities program, and was not aware that the services are offered free of charge to all municipalities. IEc informed the interviewee that this is currently the case.

being judged for lack of knowledge on the codes. One other interviewee also mentioned a fear of being judged critically for lack of codes knowledge.

Finally, IEc requested specific feedback on the plan review and inspection checklists that T.Y. Lin provides to clients. Interviewees reported that both checklists were very useful. Most interviewees (9 of 10) rated the inspection checklist as moderately useful or extremely useful; one interviewee rated the inspection checklist as somewhat useful. Most of the interviewees (7 of 10) have used both checklists (or plan to if they have not had the chance yet). However, interviewees were more likely to use the plan review checklist regularly than the inspection checklist; in two cases interviewees specified this was due to time constraints.

2.10 Municipal Support: Learning and Plans to Enact Changes

Evaluation Questions: What did the municipalities learn? What was their level of knowledge of key elements of code compliance before and after the services? What changes do municipalities plan to enact as a result of the services?

IEc asked interviewees about their familiarity with the Energy Code and whether their familiarity changed due to the services they received. In particular, IEc asked about their level of understanding of the Energy Code, their confidence level in enforcing the Energy Code, and their comfort describing how to comply with the Energy Code to colleagues or others in the design and construction communities. Most interviewees reported that their familiarity with the Energy Code increased on all three of these parameters.

In addition, IEc asked interviewees about what they learned from the services, and if they had applied their learning to their plan reviews and inspections. Interviewees reported learning in a variety of areas, the most common being documentation requirements (the information design professionals are required to provide in their plans), which four of the 10 interviewees mentioned. The second most common area of learning reported was mechanical requirements, which three of the 10 interviewees mentioned. Other areas include learning:

- To not assume that the design professional has met the Energy Code requirements, and knows more about the requirements than the code official.
- To check whether the mechanical equipment in the plans is currently available from the manufacturer.
- Techniques to achieve compliance.
- How to navigate the Energy Code.
- How to conduct the calculations required in the Energy Code.
- How to commission automatic lighting controls.
- How to use RESCheck and COMCheck to evaluate tradeoffs.
- How to properly size equipment.

All of the interviewees who reported particular areas of learning from the services (7 of 10) also reported that they have changed the way they do plan reviews and inspections due to what they learned. The remaining three interviewees did not report particular areas of learning, or report behavior change. Specifically:

- Two interviewees reported using the services exclusively due to lack of time rather than due to lack of understanding of the Energy Code. Both of these interviewees did report a general

increase in understanding of the Energy Code, but did not report any specific areas of learning or changing behavior due to the services.

- One interviewee reported a better understanding of what to look for in plan reviews, but also mentioned that the services mainly confirmed that they are only "touching the surface of the code," which they reportedly were already aware of before receiving the services. This interviewee reported that they have not yet made any changes to how they conduct their plan reviews or inspections, as they have not yet determined the specific changes needed.

2.11 Municipal Support: Effectiveness at Increasing Compliance

Evaluation Question: Do municipalities think that the support services received are an effective way to increase code compliance?

IEc asked interviewees whether they think the support services offered by T.Y. Lin are an effective way to increase code compliance, and most interviewees (4 of the 5 who responded to this question) agreed that they are effective. One interviewee suggested that a short checklist may be more effective in increasing compliance. This interviewee envisioned a one-page, double-sided checklist with one side for plan reviews and one side for inspections.

In response to other questions, IEc received the following additional relevant feedback:

- One interviewee noted that the officials that assign penalties for Energy Code violations (generally judges) do not understand the Energy Code, which makes effective enforcement more difficult.
- One interviewee noted that it is very difficult to get design professionals to make changes to comply with the plan reviews, and thinks that the State needs to step in. He advocated for a formal mechanism for code officials to file complaints to the State about design professionals who refuse changes required by code officials.
- Two interviewees noted that the NYSERDA Energy Code training only focuses on the changes rather than the entire code, and that training on the entire code would be helpful.

2.12 Other Findings

In addition to the key findings on evaluation questions discussed above, the evaluation also determined the following other findings:

Design Professionals

- While the differences observed are not statistically significant, there is a six percent increase in the percentage of trainees who use plan review services after training (compared to before training). There is no difference between the percentage of respondents who use plan review services when comparing trainees to non-trainees.
- There is no statistical difference between trainees before and after training, nor between trainees and non-trainees, with respect to:
    - How often respondents receive objections on their designs; and,
    - The percentage that use compliance software tools.

- While there is no statistical difference between the percentage of trainees and non-trainees that have added new information to either their residential or commercial designs due to the requirements of the 2016 Energy Code, there is a statistically significant and substantial difference between the percentage of trainees and non-trainees that changed the formatting of their drawings and supporting documentation for both residential and commercial designs due to the requirements of the 2016 Energy Code (26 percent and 23 percent higher for trainees, respectively).

Code Officials

- Participants report slightly higher comfort ratings in assessing compliance via the following commercial compliance paths, on a scale of one to five, where one is very uncomfortable and five is very comfortable: ASHRAE 90.1 (0.5 points higher on the rating scale), prescriptive (0.1 points higher on the rating scale), and total building performance (0.1 points higher on the rating scale).

Barriers

- The behavior survey asked all respondents if they have faced barriers to implementing changes related to the 2016 Energy Code, and if so, to identify which barriers they have faced. For design professionals, 44 percent of trainees and 42 percent of non-trainees report facing barriers. For code officials, 26 percent of participants report facing barriers, while 45 percent of non-participants report facing barriers. Table 2-21 and Table 2-22 summarize the barriers faced by both design professionals and code officials. For design professionals, there are not significant differences between the barriers faced by trainees and non-trainees; however, a substantially higher portion of code official non-participants report facing time, economic considerations, and technical feasibility barriers compared to participants.

Table 2-21. Barriers Faced by Design Professionals

Barrier[1]	Trainee (N=75)	Non-Trainee (N=36)
Cost	24%	14%
Client Preferences	17%	12%
Interaction with Contractors	15%	12%
Notes: 1) Respondents could choose more than one response		

Table 2-22. Barriers Faced by Code Officials

Barrier[1]	Participant (N=19)	Non-Participant (N=11)
Time	4%	42%
Economic Considerations	9%	33%
Political Pressure	4%	8%
Technical Feasibility	17%	33%
Notes: 1) Respondents could choose more than one response		

2.13 Findings and Recommendations

IEc suggests the following recommendations for improving NYSERDA training on implementing and enforcing the Energy Code and municipal support services, based on the findings summarized below:

Finding 1. This evaluation found some positive and for design professionals, statistically validated, training impacts. For design professionals, there is a statistically valid increase in trainees' reported levels of understanding after training, and some of the gains persist over time. For code officials, there is a positive gain in understanding after training, and in fact, participants report having a greater understanding than non-participants – even though most respondents (including non-participants) took some form of training.

Recommendation 1. Continue to offer code training to code officials and design professionals. As the impact and retention of training topics appears mixed, ***NYSERDA should consider creating more targeted training courses as one strategy to address persistence of benefits***. The largest differences in trainees' versus non-trainees' application of the Energy Code is for specific provisions. Smaller, topic-based training courses may better address potential information gaps, and attract more trainees (due to the smaller time commitment). This was also a recommendation that came out of the Phase I process evaluation.

Finding 2. It is IEc's understanding that Energy Code training courses are continually available in New York State, and that opportunities exist for refresher courses throughout the year. However, the evaluation found that design professional trainees showed some loss of knowledge over time.

Recommendation 2. Consider an outreach campaign to communicate the available resources to trainees. Increasing communication about available resources to trainees to refresh knowledge may be helpful.

Finding 3. Municipal plan review and inspection services are well-received and participants find them helpful for implementing the Energy Code. Some municipal interviewees noted that overview training would be helpful.

Recommendation 3. Continue offering plan review and inspection services to municipalities. NYSERDA may also want to consider pursuing policy change that would aid enforcement by local code officials, given comments by municipal interviewees that changes required by code officials are

sometimes blocked by design professionals. In addition, ***consider offering an overview training that covers the Energy Code in its entirety***, rather than just the changes with each new Energy Code update.

Finding 4. This evaluation found that on average, trainees appear more committed to making changes directly following training than they are once time has passed.

Recommendation 4. Consider ways to increase trainee commitment to apply their knowledge. For example, at the end of training, trainees could be asked to formally set goals that are communicated to NYSERDA, and tracked through a system monitored by trainers (or NYSERDA). By tracking commitments, NYSERDA could periodically contact trainees to remind them of their goals, discuss progress and implementation challenges, and potentially offer additional support if needed; commitments may help reinforce material covered in training. Other effective strategies for maintaining a high level of commitment in action include: (1) using interactive activities during training that encourage participation (e.g., collaborative activities, role plays, small group exercises); (2) implement post-training evaluation of skills (e.g., track and measure after training); or (3) ensure that the content is relevant to actual job duties (i.e., activities that resemble behaviors, challenges, and scenarios faced by trainees).[17]

Recommendation for Evaluation Team

Consider conducting a similar, but potentially more streamlined behavioral survey with a statistically valid sample for code officials, so that conclusions may be extrapolated to the population. This evaluation found positive results of training for code officials in particular, but those results cannot be statistically extrapolated. Having a statistically valid finding may better inform the investment of training resources moving forward. Also, given NYSERDA's intended use of this study as an attribution method for code compliance studies, having a statistically valid finding for code officials may be helpful to NYSERDA.

[17] Lisa A. Burke and Holly M. Hutchins. "A Study of Best Practices in Training Transfer and Proposed Model of Transfer." *Human Resource Development Review,* Vol. 19, No. 2, Summer 2008, pages 107-128.

3 Methods

This evaluation relied primarily upon a survey of trainees who attended NYSERDA Energy Code training and a comparison group of non-participants. IEc also conducted interviews with municipalities who received plan review and inspection support services offered by NYSERDA through contractor T.Y. Lin.

3.1 Survey

The purpose of the survey was to assess the value of NYSERDA's Energy Code trainings and to inform the development and delivery of future trainings. The survey is also a method for attributing Codes program outcomes, including changes in compliance and energy savings, to program offerings. Specifically, IEc designed the survey to assess changes in Energy Code implementation among design professionals and code enforcement officials who participated in NYSERDA's training courses between April 2015 and June 2016 and were included in IEc's pre- and post-training "knowledge survey" in Part I of the process evaluation. IEc surveyed training participants ("trainees") and non-participants ("non-trainees") for comparative purposes; the non-trainee group did not receive NYSERDA training on the New York State Energy Code updates that took effect in October 2016.

IEc created separate survey instruments for four audience groups:

1. Design professional trainees,
2. Design professional non-trainees,
3. Code official trainees, and
4. Code official non-trainees.

The survey instruments for design professionals and code officials differ in that they address specific behavior change objectives vis-à-vis code implementation for each group. The survey instruments for non-trainees ask the same questions about implementing the Energy Code, but do not include any references to NYSERDA training. Additionally, IEc included a screening question to address whether the non-trainees have received training from an entity other than NYSERDA. Each survey instrument was designed to be completed in no longer than 20 minutes.

Following survey development, IEc tested the survey over the phone with two individuals in each of the following target groups: design professional trainees and code official trainees. Non-trainees did not respond to the invitation to test the survey. The test focused on whether respondents understood the survey questions and responded to them appropriately. Survey testing revealed no major issues with comprehension or clarity in the survey instruments. IEc made minor adjustments to survey wording and order to ensure maximum effectiveness. IEc administered the final survey as a web-based survey; the final survey instruments are provided in Appendix A.

For design professionals, IEc designed the sampling plan to meet NYSERDA's 90/10 standard for confidence and precision and produce statistically valid results, which allows extrapolation of the survey results to the population. From the results of the knowledge survey, IEc identified a universe of 496

participant design professionals. According to the New York State Education Department Office of Professions, there were 17,975 registered licensed architects in the State of New York in 2015.[18] Therefore, our population of non-trainees design professionals was 14,479 (17,975-496). To ensure a statistically valid sample, IEc's sample relied on the following design parameters: a precision level of 10 percent, an estimate of variability of 50 percent, and a margin of error of 10 percent. Using these parameters, and assuming a response rate of 50 percent, IEc determined the appropriate sample size was 120 trainees and 136 non-trainees, which would result in 60 and 68 completed surveys, respectively. IEc selected design professional trainees from the training rosters and design professional non-trainees from State licensure lists. IEc took a simple random sample from these lists, meaning that each professional had an equal chance of being chosen into the sample.

For the code officials, there were a limited number of respondents included in the survey, therefore, the results from the survey cannot be used to extrapolate to all code officials. IEc selected 40 participant and 40 non-participant code officials, to yield an estimated 20 completed surveys for each group (assuming a 50 percent response rate). IEc randomly selected code official trainees from the training rosters and code official non-trainees from the official training record database maintained by the State Wide Learning Management System.

Table 3-1 summarizes participation in the survey. During implementation, the achieved response rate for all four groups was lower than the estimated 50 percent; additional sample was drawn to reach the goal number of completed surveys.

Table 3-1. Survey Participation

Group	Invitations Sent	Completed Surveys	Response Rate
Design Professionals: Trainees	477	98	21%
Design Professionals: Non-trainees	658	44	7%
Code Officials: Trainees	77	23	30%
Code Officials: Non-trainees	39	12	31%

Following the completion of survey administration, IEc analyzed the responses to the following types of questions asked in the survey:

- Yes/No Questions: The number of respondents reporting "Yes" to these questions was aggregated, and presented as a percentage of total respondents.
- Categorical Questions: All categorical questions were presented to respondents as a scale (from one to five); the responses were treated as numerical, and converted to averages. In other words, the average rating on the scale for each group.
- Open-Ended Responses: In cases where there were many responses, IEc conducted a formal coding analysis to identify the most common responses. There were a number of open-ended

[18] The New York State Department of Education Office of Professions requires a registered license to practice architecture and design in the state. This number encapsulates every registered New York State architect, whether or not they reside in New York. New York State Department of Education Office of Professions License Statistics; Profession Title: Architect. Last Updated July 12, 2016. http://www.op.nysed.gov/prof/arch/archcounts.htm

questions that generated few responses; in those cases, the responses qualitatively were summarized without formal coding.

For the design professionals, t-tests were conducted to detect differences between either proportions (for Yes/No responses), or average values (for categorical responses). These tests for statistical significance were conducted at the 90 percent confidence level. For code officials, comparisons of the differences in proportions or averages were conducted without statistical significance.

For both groups, results are presented both within and between groups. Specifically, differences between trainees' responses before and after training (within) and differences between trainees and non-trainees (between) are presented.

3.2 Municipal Support Interviews

IEc conducted interviews with 10 individuals who received plan review and/or inspection services from T.Y. Lin between late 2015 and early 2017.[19] The goal of the interviews was to qualitatively assess satisfaction with these services and changes in knowledge or behavior. IEc developed a formal interview guide, which is included in Appendix D.

Most of the interviews were conducted over the phone and lasted approximately 15 minutes on average. All interviewees were provided the opportunity to review interview questions in advance of the interview. One interviewee responded via email rather than scheduling a phone call. IEc conducted a qualitative analysis of the interview responses, rather than a formal coding analysis, due to the small number of interviews.

[19] This evaluation did not include a review of the hotline service offered; questions for municipalities focused on the higher level effort services provided by T.Y. Lin.