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REPORT #E17-353

2016 BOC Program Dataset Analysis

Prepared For NEEA:

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Memorandum

To: Amy Webb, Project Manager, MR&E, NEEA

From: Ryan Bliss, Managing Director, Zac Hathaway, Consultant 3, Research Into Action

Date: April 10, 2017

Re: 2016 BOC Program Dataset Analysis

This memo documents Research Into Action’s analysis of the Northwest Energy Efficiency Council (NEEC) Building Operator Certification (BOC) program dataset as of 2016. The primary goal of this analysis was to describe the 2016 new BOC certificants and update the count of active BOC certificants in the four Northwest (“Northwest”) states as of January 19, 2017.

The certificants counted in this memo include those in target groups of NEEA’s BOC Expansion (BOC-E) Initiative, established in 2012 to accelerate adoption of BOC and increase its market penetration in the Northwest. Those groups are: operators in underserved areas,¹ Federal employees, and members of the International Union of Operating Engineers (IUOE). Although BOC-E targets the above specific groups, NEEA’s support for BOC is not limited to those groups.

Types of Certification

Prior to 2016, NEEC awarded a certification to BOC graduates who completed certain requirements. NEEC offered two certification levels: Level I and Level II.² Starting in 2016, to align BOC with the ISO 17024 standard, NEEC established an additional and separate level of certification. Students who complete the existing BOC certification requirements receive the Training Certificate of Completion (“TCOC”) designation. Those who pass an additional exam that conforms with the 17024 Standard earn the “Certified Building Operator” (“CBO”) certification. In 2016, NEEC changed the designation of all previous BOC certificants to TCOC and allowed them to obtain the CBO status after completing the additional requirements. To implement these changes, on June 15, 2016, NEEC sent out a letter to all existing BOC Level I and Level II certificants notifying them of the following options:

- › To maintain their Level I certificate, they must sit for an exam by December 31, 2016. Those who did not pass the exam by December 31, 2016 would have their Level I certificate re-designated as a “Level I Training Certificate of Completion (TCOC).”

¹ “Underserved markets or communities” are defined as markets that BOC serves on an infrequent basis (i.e. once every three to seven years), and generally only with the active engagement of a utility sponsor or larger employer.

² Level I classes focus on HVAC controls, common opportunities for operational improvements, and building scoping for energy efficiency, key activities associated with energy efficient building operations. Level II training is designed for individuals who have completed Level I training or who have three or more years of experience working in operations and maintenance of a commercial or institutional facility.

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- › On March 31, 2017, all Level II certificates will be re-designated as a “Level II Training Certificate of Completion (TCOC).”

The distinction between TCOC and CBO is not important for calculating energy savings from NEEA’s support of BOC. Since no research has documented that savings are different for those who achieve the CBO status, NEEA counts both types of certificants equally in savings calculations. Therefore, this memo treats them as equal for counting the number of certificants and refers to them collectively as “BOC” certification.

Methods

This section describes how Research Into Action developed a BOC dataset to track year-by-year data on certificants, how we update that dataset annually with data from NEEC, and how we calculate annual counts of certificants from the data in the updated dataset.

Development of the NEEA BOC Dataset

From 2012 through 2014, Research Into Action used data from NEEC and the Intermountain Building Operators Association (IBOA) to develop a dataset of individuals employed in the Northwest that had received BOC certification from 1996 through 2014. That dataset resides on the NEEAnet SharePoint site – this memo refers to it as “the NEEA BOC Dataset.”

Each record in the NEEA BOC Dataset includes the same fields that are in the NEEC database, which contain information about the certificant and his/her employer as well as the years of BOC (now TCOC) certification and expiration of Level I and Level II certifications. As maintaining certification requires annual renewal, the year of “expiration of certification” is the year following the last year of renewal or the year of certification if the certificant did not renew certification.³ In addition, the NEEA BOC Dataset includes fields and worksheets that Research Into Action created to provide year-by-year counts of active certificants as well as to generate additional analyses of interest to NEEA.

Updating the NEEA BOC Dataset

NEEC continues to maintain a separate database of TCOC and CBO certificants in the Northwest.⁴ NEEC annually updates the BOC certification status, contact information, and employment information of certificants in its database. If a certificant retires from work or is deceased, NEEC indicates that information in the database fields that track employment data.

Each year, NEEC provides Research Into Action with a data file containing records of new TCOC recipients and BOC certificants for the four NEEA states as well as records of continuing certificants with

³ Certificants that do not renew certification in a given year may renew in a later year if they complete all the continuing education requirements for the missed years. BOC considers those individuals to have maintained certification continuously. However, if in a given year a certificant did not renew in the previous year, BOC considers the certification to have expired in the previous year.

⁴ Prior to 2014, NEEC maintained a database of Washington and Oregon BOC certificants, while IBOA maintained a separate database of Idaho and Montana BOC Certificants. In 2014, NEEC integrated the IBOA certificant data into its database and since then has maintained a database of certificants in all four states.

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updated data. Research Into Action uses that data file each year to update the NEEA BOC Dataset. At the time of the previous update, done in January 2016, the NEEA BOC Dataset contained 2,816 records.

On January 19 2017, NEEC provided Research Into Action with a data file through the end of 2016 containing 2,959 records of individuals who received their TCOC or CBO certificate and are employed in the Northwest. The 2016 NEEC data file contained a total of 36 records for individuals who passed the additional exam to earn their CBO certification. NEEC reclassified all remaining individuals as TCOC certificants. As noted above, however, for tracking and claiming energy savings for NEEA, the distinction between TCOC and CBO does not matter.

Research into Action reviewed the 2016 NEEC BOC data file to identify: 1) new certificants (i.e., individuals not already identified in the NEEA BOC Dataset) who received their BOC certification in 2016; 2) any previous certificants (i.e., individuals already existing in the NEEA BOC Dataset) with new or updated BOC certification or expiration years; 3) any certificants who received their BOC certification, but had a work state outside of the Northwest; and 4) any records with missing BOC certification or expiration years or other irregularities.

For the remainder of this memo, any mention of “certificants” includes both TCOC and CBO certificants. Certificants classified as active are all individuals who have received or renewed their credential since 2011. These are individuals for whom NEEA counts energy savings for 2016.

During the initial data review, Research Into Action staff determined that the 2016 NEEC data file did not include records for four individuals who were in the NEEA BOC Dataset. Working with NEEC, Research Into Action determined that NEEC had excluded two of these individuals from its annual update data file for NEEA because they no longer worked in the Northwest. Research Into Action retained those two records in the NEEA BOC Dataset and recorded them as being employed outside of the Northwest as of 2016.

The other two cases were individuals for whom NEEC staff accidentally deleted address information for the records, causing them not to be included in the 2016 data extract; NEEC staff reconstructed their database records using the data that Research Into Action provided. Adding those two cases increased the 2016 NEEC data file to 2,961 records.

Research Into Action also identified ten records in the 2016 NEEC data file that we determined should not be added to the NEEA BOC Dataset: eight records for individuals who received their BOC certification in 2016, but had a work state outside of the Northwest and two records for individuals who had not yet received their BOC certification. Subtracting those 10 cases decreased the 2016 NEEC data file to 2,951 records.

The data review activities described above resulted in a final NEEC data file that contained records for 2,951 individuals with BOC certification and employed in the Northwest. Of those, Research Into Action identified 144 new records of certificants (that is, records that were not already in the NEEA BOC Dataset) and 2,807 records that matched existing records in the NEEA BOC Dataset. The count of 2,807 matching records is nine fewer than the 2,816 that were in the NEEA Dataset as of the January 2016 update. Most of the discrepancy is accounted for by NEEC’s exclusion of seven records of individuals who received their BOC certification in the Northwest but moved out of state and one IBOA record that

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is not currently being tracked by NEEC.⁵ The remaining discrepancy comes from the fact that the NEEA BOC Dataset contains two records for one individual who recertified over five years after the original BOC certification had expired – one record with the new BOC certification and expiration dates, and the other with the previous certification and expiration dates. This unique case is equivalent to having two individuals with the same name and contact information but different certification and expiration dates. Maintaining both records is necessary to maintain accurate year-by-year counts of savings.⁶

Of the 2,807 matching records, 582 had updated Level I or Level II BOC certification or expiration data. Research Into Action added the 144 new certificants to the NEEA BOC Dataset and updated the Level I or Level II BOC certification or expiration data for the other 582 records. For the other 2,212 records, the 2016 NEEC data was identical to that already in the NEEA BOC Dataset so there was no need for Research Into Action to update those records. Table 1 summarizes the type of updates made.

Table 1: Summary of Disposition of 2016 NEEC Data File

Type of Record	Count
<i>Number of records received from NEEC, of individuals certified and employed in the Northwest</i>	2,951
New 2016 BOC certification records added to the NEEA BOC Dataset	144
Records matching existing records in NEEA BOC Dataset	2,807
Existing record in the NEEA BOC Dataset with 2016 BOC certification¹	13
Updated information	582
Received Level I BOC certification in 2015, but not previously counted ²	3
Received Level II BOC certification in 2015, but not previously updated ³	2
Renewals	577
Renewed Level I only	359
Renewed both Level I and Level II ⁴	158
Renewed Level I and received Level II	25
Renewed Level II only	19
Received new Level II and previously had Level I ⁴	16
No updated information³	2,212

1 These 13 individuals were added to the NEEA BOC Dataset as part of the 2015 update, but were not counted in 2015.

2 These three individuals' unique IDs changed between the 2014 and 2015 update causing them to not be counted in 2015.

3 These two individuals' unique IDs changed between the 2014 and 2015 update causing their Level II BOC certification information to not be updated in 2015.

4 Includes two records where the unique ID changed between the 2014 and 2015 causing their Level II BOC certification not to be counted.

⁵ We informed NEEC about this record as part of both the 2015 and 2016 updates.

⁶ We have documented the protocol in our *Guideline for Updating BOC Data File Memo*.

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Updating BOC Certificant Counts in the NEEA BOC Dataset

To update the count of active BOC certificants from 2015, we calculated: 1) the number of new certificants – those certified for the first time in 2016;⁷ 2) the number of prior certificants for whom, starting in 2016, NEEA no longer counts savings (“savings-retired certificants”) – those whose BOC certification had been expired more than five years (the measure life of the certification),⁸ 3) the number of certificants who left the workforce (moved out of the Northwest, retired from work, or died before their savings retired); and 4) the number of certificants who were unemployed in 2016.⁹ Additional details are in *2016 Count of Active Certificants*, below.

NEEA does not calculate savings separately for Level I and Level II BOC certification. Rather, it calculates savings from the first year of BOC certification – whether that was Level I or Level II certification¹⁰ – to the year before savings retire. For individuals with both BOC Level I and Level II certification and different certification or expiration years for the two levels ($n = 566$), we assigned a single “first year certified” as the earlier year in which the individual received either certification; and we assigned a single “last year certified” as the last year in which that individual received BOC certification at either level – the year before the later of the two expiration years. For example, if a certificant has a Level II BOC certification expiration year later than their Level I BOC certification, the later year will override the earlier year. Table 2 provides an example to illustrate this.

Table 2: Example Computation of First Year Certified and Last Year Certified

Year	Level I	Level II	Certification Status
2002	Received Certification		Certified (Level I)
2003	Renewed Certification	Received Certification	Certified (Level I and II)
2004	Did Not Renew Certification	Renewed Certification	Certified (Level I and II)
2005	Certification Expired	Renewed Certification	Certified (Level II)
2006		Did not Renew Certification	Certified (Level II – Last Year Certified)
2007		Certification Expired	Not Certified

⁷ These included individuals that already had records in the NEEA BOC Dataset but had not received certification as well as new records from NEEC.

⁸ NEEA established this assumption in 2005 (source: RLW Analytics, Inc (2005). Impact and Process Evaluation Building Operator Training and Certification Program. Accessed 3/26/2012 at http://www.theboc.info/pdf/Eval-BOC_NEEP_2005.pdf). Subsequent research has supported the assumption: Navigant Consulting (2011). Long-Term Monitoring and Tracking Report on 2010 Activities. Accessed 11/29/2011 at http://intranet.neea.org/Teams/Market-Planning/TeamWiki/Documents/NEEA_LTMT_Report_2010-11_Revised_2011-06-13%20v02_Confidential.docx, and Research Into action (2013). Final Report: BOC-Expansion Initiative Market Progress Evaluation Report

⁹ NEEC does not track the specific date when a certificant becomes unemployed or regains employment. If the NEEC update file shows someone is unemployed, we make the conservative assumption that they were unemployed the entire year. Any other assumption would complicate the calculation of savings. If a subsequent update shows the individual is employed, we will assume that the individual was employed the entire year.

¹⁰ Most BOC students who get Level II certification get Level I first, but that is not a requirement, and some students get Level II first or get only Level II.

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2016 Count of Active Certificants

The NEEC update file identified 144 new records with 2016 BOC certifications and showed 2016 BOC certifications for 13 individuals that were already in the NEEA BOC Dataset from the 2015 update. Thus, 157 individuals received BOC certification for the first time in 2016 (72 through BOC-E). The updated data also showed 161 certificants whose savings retired that year. In all, the updated combined NEEA BOC Dataset consists of 2,951 individuals employed in NEEA territory that had received certification since 1996, of whom 1,566 are currently active certificants as defined above.

Table 3 shows the year-by-year counts from 1996 through 2016. Each row shows, for a given year, the number of new certificants, the number of prior certificants whose savings have retired (“savings-retired certificants”), and the cumulative number of active certificants. The latter number is equal to the number of continuing certificants from the previous year plus the number of new certificants, minus the number of savings-retired certificants.

The number of “active” certificants in any given year also should exclude the total number of prior certificants who retired from work or died before their savings retired or who were unemployed in that year. The NEEC BOC database does not record the year of death, work retirement, or unemployment, so we could not subtract such individuals from any given year’s cumulative total when we first identified the need to do so in 2014. In that year, we identified 17 individuals who reported work retirement or were deceased before their savings would have retired and eight who were unemployed, for a total of 25. Since we could not subtract them from any given year’s cumulative total, we subtracted them from the 2013 cumulative total and instituted a procedure to identify new cases of individuals leaving the workforce before savings retirement going forward.

By comparing each year’s new NEEC BOC data file to the NEEA BOC Dataset, we can identify the year of all new individuals who left the workforce before their savings would have retired. The combined 2016 BOC Dataset shows 12 additional individuals who left the workforce before their savings retired (seven in 2014, five in 2015, and none in 2016). This includes those certificants that died, retired, or who were unemployed or gained employment outside of the Northwest. We included those 12 individuals in the counts of “Saving Retired or Left Workforce” for each respective year.

Table 4 shows the year-by-year counts of new, retired, and total active certificants by the state the certificant reported working in.

Finally, Table 5 shows the year-by-year counts of new, retired, and total active certificants grouped into NEEC certificants or IBOA certificants. The dataset does not provide comprehensive information on training provider, so we assumed that all certificants that work in Oregon or Washington received certification through NEEC and those that work in Idaho or Montana received IBOA certification.

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Table 3: Market Status of Active Certified Building Operators

Year	Annual New ¹			Saving Retired or Left Workforce Early ²			Re-entered Workforce ³			Cumulative Total Active ⁵
	BOC	BOC-E ⁵	Total	BOC	BOC-E ⁴	Total	BOC	BOC-E	Total	
1996	9	0	9	0	0	0	0	0	0	9
1997	1	0	1	0	0	0	0	0	0	10
1998	61	0	61	0	0	0	0	0	0	71
1999	143	3	146	0	0	0	0	0	0	217
2000	152	0	152	0	0	0	0	0	0	369
2001	102	0	102	0	0	0	0	0	0	471
2002	202	0	202	0	0	0	0	0	0	673
2003	164	0	164	0	0	0	0	0	0	837
2004	93	0	93	6	0	6	0	0	0	924
2005	145	0	145	89	0	89	0	0	0	980
2006	101	0	101	105	0	105	0	0	0	976
2007	103	1	104	75	0	75	0	0	0	1,005
2008	201	3	204	106	0	106	0	0	0	1,103
2009	121	3	124	112	0	112	0	0	0	1,115
2010	177	4	181	86	0	86	0	0	0	1,210
2011	164	18	182	127	0	127	0	0	0	1,265
2012	119	98	217	86	0	86	0	0	0	1,396
2013	48	117	165	77	0	77	0	0	0	1,484
Left workforce ⁶	--	--	---	17	8	25	0	0	0	--

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Continued

Year	Annual New ¹			Saving Retired or Left Workforce Early ²			Re-entered Workforce ³			Cumulative Total Active ⁵
	BOC	BOC-E ⁵	Total	BOC	BOC-E ⁴	Total	BOC	BOC-E	Total	
Subtotal in 2013	2,106	247	2,353	886	8	894	0	0	0	1,459
2014 ⁷	42	170	212	218	2	220	0	0	0	1,451
2015 ⁷	37	192	229	113	0	113	1	1	2	1,569
2016	85	72	157	161	0	161	0	1	1	1,566
Total in 2016	2,270	681	2,951	1,378	10	1,388	1	2	3	1,566

- 1 New = first certified in that year.
- 2 Savings Retired = BOC certification expired more than five years. Left Workforce Early = deceased, retired from employment, no longer works in the Northwest, or unemployed before savings would have retired.
- 3 Re-Entered Workforce = certificant “left workforce early” (see previous footnote) and then re-entered the workforce before savings became retired. This set of columns is necessary to account for the fact that such certificants were not actively contributing to Northwest savings for a specific period of time.
- 4 This column records the year of initial BOC certification for each individual who received any certification in the BOC-E Initiative. This includes 32 students who received their first BOC certification before the BOC-E Initiative began in 2012, and then achieved a second certification through BOC-E in 2012 or later.
- 5 Cumulative Total Active (present year) = Total Active (previous year) + Annual New - Annual Retired, Left Workforce Early, or Unemployed + Re-entered Workforce.
- 6 This row shows the total number of individuals that had left the workforce before their savings would have retired because of work retirement or death (17) and the total unemployed (8) as of 2013. In 2015, we began tracking the year in which the death, work retirement, or unemployment occurred.
- 7 The “Left Workforce Early” column includes seven individuals who left the workforce early in 2014 and five individuals who left the workforce in 2015.

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Table 4: Market Status of Active Certified Building Operators, by State¹

Year	Annual New ¹				Saving Retired or Left Workforce Early ²				Re-entered Workforce ³				Cumulative Total Active ⁴			
	OR	WA	ID	MT	OR	WA	ID	MT	OR	WA	ID	MT	OR	WA	ID	MT
1996	0	0	9	0	0	0	0	0	0	0	0	0	0	0	9	0
1997	0	1	0	0	0	0	0	0	0	0	0	0	0	1	9	0
1998	0	49	12	0	0	0	0	0	0	0	0	0	0	50	21	0
1999	46	81	14	5	0	0	0	0	0	0	0	0	46	131	35	5
2000	53	76	22	1	0	0	0	0	0	0	0	0	99	207	57	6
2001	38	57	0	7	0	0	0	0	0	0	0	0	137	264	57	13
2002	33	123	31	15	0	0	0	0	0	0	0	0	170	387	88	28
2003	11	93	47	13	0	0	0	0	0	0	0	0	181	480	135	41
2004	21	38	2	32	0	0	6	0	0	0	0	0	202	518	131	73
2005	30	88	16	11	20	63	5	1	0	0	0	0	212	543	142	83
2006	16	64	8	13	37	45	23	0	0	0	0	0	191	562	127	96
2007	28	61	8	7	23	49	1	2	0	0	0	0	196	574	134	101
2008	22	120	20	42	19	68	14	5	0	0	0	0	199	626	140	138
2009	18	67	24	15	19	54	31	8	0	0	0	0	198	639	133	145
2010	15	97	4	65	16	40	13	17	0	0	0	0	197	696	124	193
2011	53	101	10	18	26	69	15	17	0	0	0	0	224	728	119	194
2012	69	114	0	34	19	51	7	9	0	0	0	0	274	791	112	219
2013	41	104	9	11	21	48	4	4	0	0	0	0	294	847	117	226
Left workforce ⁶					2	20	2	1								
Subtotal in 2013	494	1,334	236	289	202	507	121	64	0	0	0	0	292	827	115	225

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Year	Annual New ¹				Saving Retired or Left Workforce Early ²				Re-entered Workforce ³				Cumulative Total Active ⁴			
	OR	WA	ID	MT	OR	WA	ID	MT	OR	WA	ID	MT	OR	WA	ID	MT
2014 ⁷	33	131	23	25	29	111	32	48	0	0	0	0	296	847	106	202
2015 ⁷	35	114	55	25	18	72	15	8	0	2	0	0	313	891	146	219
2016	58	55	32	12	14	68	11	68	0	1	0	0	357	879	167	163
Total in 2016	620	1,634	346	351	263	758	179	188	0	3	0	0	313	891	146	219

- 1 New = first certified in that year.
- 2 Savings Retired = BOC certification expired more than five years. Left Workforce Early = deceased, retired from employment, no longer works in the Northwest, or unemployed before savings would have retired.
- 3 Re-Entered Workforce = BOC certificant “left workforce early” (see previous footnote) and then re-entered the workforce before savings became retired. This set of columns is necessary to account for the fact that such certificants were not actively contributing to Northwest savings for a specific period of time.
- 4 This column records the year of initial BOC certification for each individual who received any certification in the BOC-E Initiative. This includes 32 students who received their first BOC certification before the BOC-E Initiative began in 2012, and then achieved a second certification through BOC-E in 2012 or later.
- 5 Cumulative Total Active (present year) = Total Active (previous year) + Annual New - Annual Retired, Left Workforce Early, or Unemployed + Re-entered Workforce.
- 6 This row shows the total number of individuals that had left the workforce before their savings would have retired because of work retirement or death (17) and the total unemployed (8) as of 2013. In 2015, we began tracking the year in which the death, work retirement, or unemployment occurred.
- 7 The “Left Workforce Early” column includes seven individuals who left the workforce early in 2014 and five individuals who left the workforce in 2015.

Table 5: Market Status of Active Certified Building Operators, by NEEC and IBOA Certificants¹

Year	New		Saving Retired or Left Workforce Early		Re-Entered Workforce		Cumulative Total Active	
	NEEC	IBOA	NEEC	IBOA	NEEC	IBOA	NEEC	IBOA
1996	0	9	0	0	0	0	0	9
1997	1	0	0	0	0	0	1	9
1998	49	12	0	0	0	0	50	21
1999	127	19	0	0	0	0	177	40
2000	129	23	0	0	0	0	306	63
2001	95	7	0	0	0	0	401	70
2002	156	46	0	0	0	0	557	116
2003	104	60	0	0	0	0	661	176
2004	59	34	0	6	0	0	720	204
2005	118	27	83	6	0	0	755	225
2006	80	21	82	23	0	0	753	223
2007	89	15	72	3	0	0	770	235
2008	142	62	87	19	0	0	825	278
2009	85	39	73	39	0	0	837	278
2010	112	69	56	30	0	0	893	317
2011	154	28	95	32	0	0	952	313
2012	183	34	70	16	0	0	1,065	331
2013	145	20	69	8	0	0	1,141	343
Left workforce < 2014			22	3				
Subtotal in 2013	1,830	525	710	186	0	0	1,120	339
2014	164	48	140	80	0	0	1,119	340
2015	149	80	90	23	2	0	1,204	365
2016	113	44	82	79	1	0	1,236	330
Total in 2016	2,254	697	1,021	367	3	0	1,236	330

- 1 Annual New = BOC certified in that year. Annual Retired = did not receive a new certification or renewal within the previous five years. Total Active (present year) = Total Active (previous year) + Annual New – Annual Retired.
- 2 For each column, total inactive is the sum of savings retired, work retired or deceased before savings retired, and unemployed.
- 3 For each column, total active is the sum of total new minus total inactive.

BOC Expansion Attributes

The 2016 NEEA BOC Dataset includes information relevant to the BOC expansion (BOC-E) efforts. It identifies individuals who attended any of three types of classes introduced through the Initiative: *Large Employer*, or classes formed through the Initiative’s outreach to large employers; *Underserved*, or classes held in previously underserved areas; and *Online*, or classes that incorporate online modules. The dataset also identifies individuals who are members of any of four groups that the Initiative has targeted: certificants that received training from the International Union of Operating Engineers (IUOE); returning veterans who served in Afghanistan or Iraq (2001 to 2012); federal employees; and the unemployed. For brevity, this memo refers to having received training in the three BOC-E classes and membership in the four targeted groups as BOC-E “attributes.”

As of 2016, 674 individuals have one or more of the above attributes. Of those individuals, 623 received BOC certification for the first time from 2012 through 2016 (“new BOC certificants”) and 51 had received BOC certification before 2012 (typically Level I) but received an additional certification through BOC-E (typically Level II) from 2012 through 2016 (“continuing BOC certificants”).¹¹ Table 6 shows counts for various attributes of BOC-E certificants.¹²

When NEEA launched the BOC-E initiative, it targeted unemployed trainees as well as veterans who served from 2001 to 2012 (the Afghanistan and Iraq era); it also tracked veterans who served before 2001. As of the year of this report, BOC-E does not target the unemployed, but continues to track them in the NEEA BOC Dataset (Table 7).

Suggestion for Future Research

As noted above, currently NEEA treats TCOC and CBO certificants as equivalent in terms of generated savings. Similarly, NEEA does not calculate savings separately for Level I and Level II certificants.

In a recent BOC-related evaluation for Massachusetts program administrators,¹³ Research Into Action addressed whether it is reasonable to claim a higher level of savings for subsidizing BOC Level II certification than for Level I certification. Research Into Action re-analyzed survey data from the BOC-E MPER #1 and found that the mean estimated energy savings for the 74 sites represented by Level II BOC students were higher than for the 138 sites represented by Level I students: 80% higher for electricity and 87% higher for gas.

¹¹ Some BOC certificants are both “new” and “continuing” as they received a Level I certification between 2012 and 2015 and Level II in 2016 – therefore they were counted as “new” for the Level I certification and as “continuing” for Level II.

¹² As individuals may possess more than one of the attributes found in the table, the total of the line items may exceed the total of unique BOC-E certificants.

¹³ *Comprehensive Review of Non-Residential Training and Education Programs, with a Focus on Building Operator Certification*. Prepared for Massachusetts Program Administrators and the Energy Efficiency Advisory Council by Navigant Consulting, Inc. and Research Into Action, Inc., June 19, 2015. Accessed on March 24, 2017 from <http://www.theboc.info/wp-content/uploads/2015/09/Training-and-Education-Programs-Final-Report-0601915-clean.pdf>.

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We cannot conclude, however, that it was the additional training that produced the greater savings. It is possible that the operators who take Level II training are more experienced, trained, or motivated on average, than those who do not take Level II training, and so would have produced greater savings than other operators even if they had not taken the Level II training.¹⁴ What is needed to answer this question is either to assess savings for some group of operators before and after they take Level II training or to statistically control for every difference between Level I and Level II trainees that might likely account for a difference in energy savings.

The statistical control could be done in at least two manners. One way would be to conduct an annual survey of Level I operators to identify those that plan to take Level II training and to assess their O&M activities before and after the Level II training. The alternative approach would be a longitudinal study of all BOC operators, with periodic assessment of O&M activities. This would permit a “naturalistic study” of the effects of Level II certification. As there likely would not be a sufficient number of Level II certificants in any one- or two-year period to generate reliable comparisons, either of these approaches likely would require several years’ worth of data.

Assessing differences between TCOC and CBO would be more straightforward. While a difference in mean savings between *Level I and Level II* graduates could reflect *either* an effect of the additional training *or* a self-selection effect, any difference between TCOC and CBO certificants likely reflects a self-selection effect. This is because the only difference in the two groups’ educational experience with BOC is the completion of the CBO exam.¹⁵ The main concern is that some BOC graduates may not take the CBO exam at the first opportunity but may plan to take it later. Such graduates may be more similar to those who do take the exam at the first opportunity than to those who never take it. Thus, to achieve a reliable assessment of the difference in energy savings between TCOC and CBO graduates, it may be necessary to include only graduates that had been out of training long enough to provide relative certainty that, if they had not yet achieved the CBO certification, they were not likely to do so in the future.

¹⁴ In fact, the Level II respondents were responsible for more equipment areas, on average, than were the Level I respondents (5.8 vs. 4.9), but that 20% difference in number of equipment areas would not by itself explain the at least 80% advantage in savings. Nor was the difference attributable to differences in the types of equipment they were responsible for.

¹⁵ Conceivably, taking the exam itself could have an effect by reinforcing the training, but this likely would be minimal.

Table 6: BOC Expansion Special Class Type (Multiple Selections Allowed; n = 674)

Attribute Type	New BOC-E Certificants ¹						Continuing BOC-E Certificants Receiving Additional Certification ²						All BOC-E Certificants					
	2012	2013	2014	2015	2016	Total	2012	2013	2014	2015	2016	Total	2012	2013	2014	2015	2016	Total
ATTENDED SPECIAL BOC-E CLASS																		
Large Employer	38	72	96	61	23	267	0	18	5	8	1	31	38	90	101	69	54	298
Underserved	25	46	70	114	47	255	0	10	1	7	0	18	25	56	71	121	65	273
Online Class	0	12	93	25	2	130	0	0	1	0	0	1	0	12	94	25	3	131
Attended Any Special Class ³	62	103	165	189	72	519	0	27	6	15	1	48	62	130	171	204	120	567
TARGETED GROUP																		
IUOE is Education Provider	0	10	1	0	0	11	0	0	0	0	0	0	0	10	1	0	0	11
Federal Employee	1	2	10	26	1	39	0	0	1	0	0	1	1	2	11	26	2	40
Unemployed	24	1	0	0	0	25	0	3	0	0	0	3	24	4	0	0	3	28
In Any Targeted Group ⁴	25	13	11	26	1	75	0	3	1	0	0	4	25	16	12	26	5	79
ANY BOC-E ATTRIBUTE (ATTENDED SPECIAL CLASS OR IS IN TARGETED GROUP)																		
Any BOC-E Attribute ⁵	85	111	166	189	72	623	0	29	6	15	1	51	85	140	172	204	73	674

1 These are individuals who received their initial BOC certification between 2012 and 2016.

2 These are individuals who: a) received their initial BOC certification before 2012 and then received a second certification between 2012 and 2016; or b) received their initial BOC certification in 2012 and then received a second certification between 2013 and 2016. Since BOC-E began in 2012, there are no continuing BOC-E certificants in that year.

3 Large employer, underserved, and/or online class. An individual may be in more than one of these three groups. Therefore, this number does not equal the sum of the counts for the three special classes.

4 Includes IUOE as education provider, federal employee, and unemployed. Initially also included veterans, but those are no longer targeted.

5 Includes large employer, underserved, online class, IUOE as education provider, federal employee, and unemployed. Some respondents were in more than one of these groups; therefore, this count is not the sum of the various other counts.

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Table 7: Other Tracked Associations (Multiple Selections Allowed; $n = 194$)¹

Association	Pre-2012	2012	2013	2014	2015	2016	Total
Returning Veteran (pre-2001)	4	21	22	21	25	14	107
Returning Veteran (2001-2012)	0	4	6	5	8	6	29
IUOE Other Than as Education Provider	11	16	9	18	16	1	71
Any of the above	15	38	35	40	46	20	194

1 Counts from this table are separate from the counts in .