Giving Credit Where Credit is Due: Assessing Attribution and Savings from a Building Energy Code Compliance Enhancement Program

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Since 2014, PAs have funded CCSI to increase compliance rates
  - CCSI offers training to building professionals and code officials
MA on three-year code update schedule
  - Market is always *catching-up*
  - CCSI is a way to fill the gap generated by lower NC program savings
Evaluation measured impact of trainings on compliance enhancement and associated savings
  - *Goal was to estimate attributable savings for the 2019-2021 program period*
Application for Others

• Regular code updates are prevalent in many jurisdictions outside of Massachusetts
• Potential to leverage this research
  ✔ Indicators required to measure impacts
  ✔ Data sources that can be used to inform new construction trends
  ✔ Lessons learned to anticipate building code cycles, impacts, and training needs
  ✔ Applicability of methodology to other jurisdictions
Timeline

2006 IECC Enforcement Begins 10/17/2008

2009 IECC Enforcement Begins 7/1/2010
~5% increase in efficiency over the 2006 IECC

2012 IECC Enforcement Begins 7/1/2014
~20% increase in efficiency over the 2009 IECC

2015 IECC Enforcement Begins 1/1/2017
~8% increase in efficiency over the 2012 IECC

2009
7/1/2010
Stretch Code Enforcement Begins
~20% more efficient than the 2009 IECC

2012 IECC Begins

2014
11/1/2014
CCSI Training on Commercial

2015 IECC Begins

2016
1/1/2017
Updated Stretch Code Enforcement Begins
~10% more efficient than the 2015 IECC

2018
2018 Baseline Study
All of 2012 IECC

2014 Baseline Study
Late 2009 IECC

2012 Baseline Study
Late 2006 IECC to Early 2009 IECC

9/15/2016
CCSI Training on Commercial
Methodology

1. The team provided Delphi panelists with background information
   - Historic changes to the building energy code
   - Changes in compliance rates
   - CCSI activities & reported improvements
   - Efforts of other organizations

2. Delphi panel estimated code compliance under two scenarios

3. The team estimated gross technical potential by comparing baseline practices to two prescriptive code pathways
   - 2015L IECC: Lighting performance pathway
   - 2015H IECC: HVAC performance pathway

4. The team estimated program net savings

CCSI continues 2018-2021
CCSI never existed
Data Sources

• Statewide commercial code compliance baseline studies
  – 2012, 2014, and 2018
• Gross technical potential modeling results
  – Estimated measure-level GTP associated with non-compliance
• CCSI training materials and survey results
• Dodge data on commercial new construction activity
• Data summarized in a “situation memo” for Delphi panelists
Identifying Factors Affecting Code Compliance

- Changes to Code
  - ‘06-‘09 IECC ~5%
  - ‘09-‘12 IECC ~20%
  - ‘12-‘15 IECC ~8%

- Changes in Compliance
  - Late ‘06 (82%)
  - Early ‘09 (76%)
  - Late ‘09 (85%)
  - All ‘12 (88%)

- CCSI Efforts
  - 52 classroom trainings between ‘14 and ‘17
  - 1,089 unique attendees
  - 75% of attendees said they would use information within three months

- Efforts of Other Organizations
  - Other organizations and secondary research suggested that the CCSI was the primary code training mechanism
Delphi Panel Composition

- Recruited 11 of 31 experts to participate in panel
  - Local code officials, architects, and engineers
  - Building efficiency consultants and evaluators working nationally
- Panelists were selected based on their familiarity with local code issues or with similar programs in other jurisdictions
• Panel was provided with a *situation memo*, summarizing the key factors affecting code compliance
• Two rounds
• Estimated compliance for commercial buildings from 2018-2021
  – Assuming the CCSI continues training and outreach
  – Assuming the CCSI was never implemented
Panelists estimated compliance with and without the CCSI for 2018-2021

Each panelist provided rationale for their responses

Panelists were provided anonymous responses of other panelists and their rationale

Panelists were asked to revisit their original estimate in light of other responses
Delphi Panel Results

Estimated Compliance with the CCSI

<table>
<thead>
<tr>
<th></th>
<th>Round 1 Average</th>
<th>Round 2 Average</th>
<th></th>
<th>Round 1 Average</th>
<th>Round 2 Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>91%</td>
<td></td>
<td>2018</td>
<td>78%</td>
<td></td>
</tr>
<tr>
<td>2019</td>
<td>92%</td>
<td></td>
<td>2019</td>
<td>78%</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>93%</td>
<td></td>
<td>2020</td>
<td>79%</td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td>93%</td>
<td></td>
<td>2021</td>
<td>80%</td>
<td></td>
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<td></td>
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</table>

Estimated Compliance without the CCSI

<table>
<thead>
<tr>
<th></th>
<th>Round 1 Average</th>
<th>Round 2 Average</th>
<th></th>
<th>Round 1 Average</th>
<th>Round 2 Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td></td>
<td></td>
<td>2018</td>
<td>82%</td>
<td></td>
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<tr>
<td>2019</td>
<td></td>
<td></td>
<td>2019</td>
<td>83%</td>
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<td>2020</td>
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<td>84%</td>
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<td>2021</td>
<td></td>
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<td>2021</td>
<td>84%</td>
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- Round two results exclude two statistical outliers (both code officials)
- Outlier responses were presented for peers to review as part of the second round
- Outliers were only removed after completion of the second round
Attribution Calculations (2019 Example)

- Compliance with the CCSI (A): **94%**
- Compliance without the CCSI (B): **83%**
- Compliance if CCSI ceased implementation (C)
  - \((A+B)/2: 89\%\)
- Compliance increase attributable to the CCSI (D)
  - \((A-C): 6\%\)
- Proportion of GTP savings attributable to CCSI (E)
  - \(D/(1-C_{2017}): 45\%\)
Gross Technical Potential Savings

• Baseline technical potential calculated by modeling baseline results compared to 2015 IECC code requirements
  – Only below-code measures included
  – Considered lighting and HVAC compliance pathways
  – Developed EUI savings for each compliance pathway
  – Averaged pathway savings to come up with an overall GTP estimate

• Dodge data used to project the growth in the commercial new construction sector
Estimated Net Savings

*Program Net Savings\textsubscript{year} = Program Attribution\textsubscript{year} \times Gross Technical Potential\textsubscript{year}*  

<table>
<thead>
<tr>
<th>Year</th>
<th>Electric (MWh)</th>
<th>Gas (therms)</th>
<th>Savings in MMBTU</th>
</tr>
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<tbody>
<tr>
<td>2019</td>
<td>5,298</td>
<td>(6,129)</td>
<td>18,027</td>
</tr>
<tr>
<td>2020</td>
<td>7,507</td>
<td>(8,685)</td>
<td>25,543</td>
</tr>
<tr>
<td>2021</td>
<td>7,621</td>
<td>(8,816)</td>
<td>25,930</td>
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<tr>
<td>3-year Total</td>
<td>20,426</td>
<td>(23,630)</td>
<td>69,501</td>
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Conclusions and Recommendations

Recognize the need to capture a **variety of data types** when designing compliance enhancement programs.

Leverage **multiple sources of data** to develop reasonable assumptions regarding commercial new construction building trends.

Account for the **timing of building energy code cycles**, related impacts, and training needs.

Thoughtfully examine the **feasibility and value** of a comparable assessment.
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