Independent Statistics & Analysis
U.S. Energy Information Administration

Residential and Commercial Sector Energy Code Adoption and Compliance Rates

November 2017

Independent Statistics & Analysis
www.eia.gov

U.S. Department of Energy
Washington, DC 20585

This report was prepared by the U.S. Energy Information Administration (EIA), the statistical and analytical agency within the U.S. Department of Energy. By law, EIA's data, analyses, and forecasts are independent of approval by any other officer or employee of the United States Government. The views in this report therefore should not be construed as representing those of the U.S. Department of Energy or other federal agencies.

Residential and Commercial Sector Energy Code Adoption and Compliance Rates

Building energy codes cover the building structure, including walls, floors, ceiling insulation, windows, air leakage, and duct leakage. Code adoption and compliance rates affect commercial and residential energy consumption by changing the energy efficiency of a building. The U.S. Energy Information Administration (EIA) contracted this report from ICF International, L.L.C. in order to inform modeling and analysis of domestic building energy consumption. Appliance and equipment standards affecting energy-using items that go into a building are not covered in this report. However, there is some overlap with building codes, particularly in lighting. Although building energy codes are adopted at the state and local levels, national model energy codes are developed by two private organizations; the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) and the International Code Council. ASHRAE develops model commercial energy codes and the International Code Council develops the International Energy Conservation Code (IECC) that contains model building energy codes for commercial and residential buildings.

The code adoption rate describes the percentage of states in a given U.S. Census division that have adopted a baseline energy code, for residential or commercial buildings, over time. Most states use a version of the ASHRAE or IECC model codes without amendments. Some states have no energy codes, and other states have modified the model codes.

The code compliance rate describes the percentage of new builds in a given U.S. Census division that fully comply with a stated building energy code. Compliance is calculated at the state level by the average percent of energy code requirements met and weighted by energy consumption. Enforcement of building energy codes is traditionally done at the local level where plans are typically reviewed before construction and field inspections are conducted during and after construction.

As part of its *Annual Energy Outlook (AEO)*, EIA models the consumption of energy in the residential and commercial sectors. EIA's National Energy Modeling System (NEMS) uses building code adoption rates as part of the assumptions for the Residential and Commercial building sectors. In both the Residential and Commercial models, shell efficiency of a building envelope is an important determinant of the heating and cooling loads for each type of building. Improvements in the heating and cooling loads of buildings reduce the amount of energy needed for these buildings. Also, purchasing decisions for new heating and cooling technologies take into account the heating and cooling loads.

The analysis from this report estimates that states will reach 100% adoption with 2009 IECC (or equivalent) codes by 2017 (Figure 2) and 100% adoption with ASHRAE 90.1-2007 (or equivalent) codes by 2022 (Figure 3). The analysis estimates states will reach 90% compliance with 2009 IECC and ASHRAE 90.1-2007 (or equivalent) by 2025 (Figure 4 & 5).

When referencing the contract report in the Appendix, it should be cited as a report by ICF International, L.L.C. prepared for the U.S. Energy Information Administration.

APPENDIX

Building Codes Program

Residential and Commercial Sector Energy Code Adoption and Compliance Rates

Final, Version 1.0

July 08, 2016

Submitted to:

Erin Boedecker
U.S. Energy Information Administration
Buildings Energy Consumption and Efficiency Analysis

Submitted by:

ICF Incorporated, L.L.C.

Under contract to Z, INC.

Table of Contents

List of Figures

ACRONYMS, ABBREVIATIONS, AND INITIALISMS

ARRA	American Recovery and Reinvestment Act of 2009
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BCAP	Building Code Assistance Project
CDM	Commercial Demand Module
DOE	U.S. Department of Energy
EIA	U.S. Energy Information Administration
HVAC	Heating, Ventilation, and Air-Conditioning
ICF	ICF International
IECC	International Energy Conservation Code
NEMS	National Energy Modeling System
OCEAN	Online Code Environment and Advocacy Network
PATH	Partnership for Advancing Technology in Housing
RDM	Residential Demand Module

INTRODUCTION

Background

The U.S. Energy Information Administration's (EIA) *Annual Energy Outlook* (AEO) provides a long-term analysis of U.S. energy markets. The forecasts are developed following the methodologies in the Commercial Demand Module (CDM) and theResidential Demand Module (RDM) of the National Energy Modeling System (NEMS). They include base and alternative scenario assumptions for various rates of adoption and compliance with residential and commercial building energy codes and standards.

Scope of Work

This report summarizes the literature research and data analysis methods used to develop estimates for the adoption and compliance assumptions used in NEMS. Forecasts were developed to estimate the rates at which individual states adopt and comply with the RDM and CDM baseline energy codes and standards (2009 IECC and ASHRAE 90.1-2013, respectively). This work improves EIA's understanding of the rates at which U.S. states are assumed to adopt and comply with residential and commercial building energy codes over time.

A workflow of the project's scope is presented below in **Figure 1**, which depicts how the research and analysis for nationwide energy code adoption and analysis will ultimately funnel into modeling and development of NEMS input values:

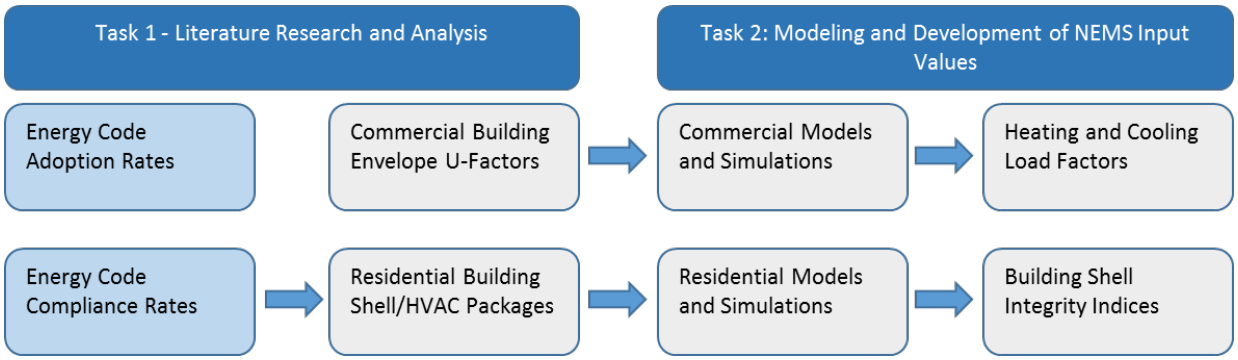


Figure 1 – Building Codes Program Task Workflow

Data collected through literature research may support development of future work products as illustrated in the workflow process of **Figure 1**. The results of this work are relevant as NEMS inputs, but they are also a first step in development of residential *Building Shell Integrity Indices* and commercial *Heating and Cooling Load Factors*,

LITERATURE RESEARCH

Approach

ICF performed secondary literature research using existing bodies of publicly available work to estimate state-level code adoption and compliance rates. These rates were aggregated to the U.S. Census division using the approach described in this report. The analysis was performed for the Residential Demand Module (RDM) and the Commercial Demand Module (CDM) baseline energy codes and standards: 2009 IECC and ASHRAE Standard 90.1-2013, respectively. Data sources included websites, research papers, and recent code baseline and compliance studies. ICF reviewed these sources for content, similarity, consistency, and dates of publication. Relevant research data was then cataloged in a data model that collected current state energy code practices and behavior in order to forecast state adoption and compliance rates. Previous studies served as benchmarks for quality assurance of estimated code adoption and compliance rates.

ICF also considered compliance rates for existing building construction; however, insufficient data was available from the resources and literature reviewed to estimate compliance in existing building construction for both the residential and commercial sectors.

Resources

ICF identified several key data sources during the literature review that underlie the adoption and compliance analysis. Specifically, the U.S. Department of Energy (DOE) Building Energy Codes Program[1,2], the Building Code Assistance Project (BCAP)[3], and the Online Code Environment and Advocacy Network (OCEAN)[4] provide data on how each state has historically adopted various energy codes and which codes are now in effect. The American Council for an Energy Efficiency Economy (ACEEE)[5] conducts an annual assessment of state energy efficiency practices, including building code adoption and compliance behavior, which provided a common baseline for mapping compliance rates to states where no data was available. Additional resources used to support the study are listed in **Appendix A**.

[1] U.S. Department of Energy, Building Energy Codes Program, Status of State Energy Code Adoption.

[2] U.S. Department of Energy, Building Energy Codes Program, Compliance.

[3] Building Codes Assistance Project, Tools.

[4] Online Code Environment & Advocacy Network.

[5] American Council for an Energy-Efficient Economy, State and Local Policy Database.

CODE ADOPTION

Definition

The code adoption rate describes the percentage of states in a given U.S. Census division (as defined by the U.S. Department of Energy) that have adopted a baseline energy code (residential or commercial) over time. For example, the adoption rate of the 2009 IECC residential code is determined by tracking the percentage of states nationwide that have adopted this code (or another energy code of equal stringency), beginning from the base year (2009) up until the year the code is adopted by 100 % of states (2018). In this example, the future adoption years (2017, 2018) for some states are projected based on historical data or other research.

Research

DOE provides state-level determinations for each model energy code update. These typically occur within one year of the code's issuance, with states having two years from determination to either adopt the code or provide justification for not adopting. Despite federal requirements, the adoption of building energy codes varies by state and across each state's jurisdictional boundaries.

Adoption of energy codes at the state level is well-cataloged on federal and industry websites such as DOE Building Energy Codes Program, the Building Code Assistance Project (BCAP), and the Online Code Environment and Advocacy Network (OCEAN). These sites provide current state residential and commercial codes, adoption dates, and unique state code amendments. Most states use versions of the IECC and ASHRAE model codes without amendments. Some states, however, are home rule states with no energy codes, while others may adopt the model codes with their own state-specific amendments that may improve or reduce the code's stringency.

Despite the availability of data for energy code adoption at the state level, there may be a lack of uniformity in adoption across a given state. Most states adopt energy codes at the jurisdictional level where the code is enforced; however, some jurisdictions have no codes, while others may use older code versions or may have adopted newer or more aggressive codes.

Analysis

ICF's analysis catalogs current state-level energy codes and/or their equivalencies as well as the year they were adopted. For states that have not yet adopted the baseline residential and commercial codes (2009 IECC and ASHRAE Standard 90.1-2013, respectively), ICF uses estimated, forecasted dates of adoption and compliance. BCAP was used as the primary resource for cataloging current state adoption practices; supplementary resources (primarily DOE Building Energy Code Program) were used to adjust either the adopted code or the adoption year.

Not all states have formally adopted editions of IECC or ASHRAE Standards. In these cases, ICF's analysis classifies these states according to their true IECC- or ASHRAE-equivalents. BCAP's website analyzes each state's code and state-specific amendments (if applicable) and maps them to their code equivalents.

ICF reviewed data from the Pacific Northwest National Laboratory (PNNL) study[6] (which underpins the *AEO2015* report), to estimate adoption and compliance data where gaps occurred. The work conducted in the PNNL study extrapolates adoption data by categorizing states into three categories (aggressive, moderate, and slow) based on historical energy code adoption patterns and legislative activity.

Figure 2 and **Figure 3** illustrate the projected national residential and commercial model code adoption rates, respectively. The rates are forecasted from their baseline year until a maximum 100% adoption (all states) has been reached at some future year. Forecasted adoption rates by U.S. Census division are provided in **Appendix B**.

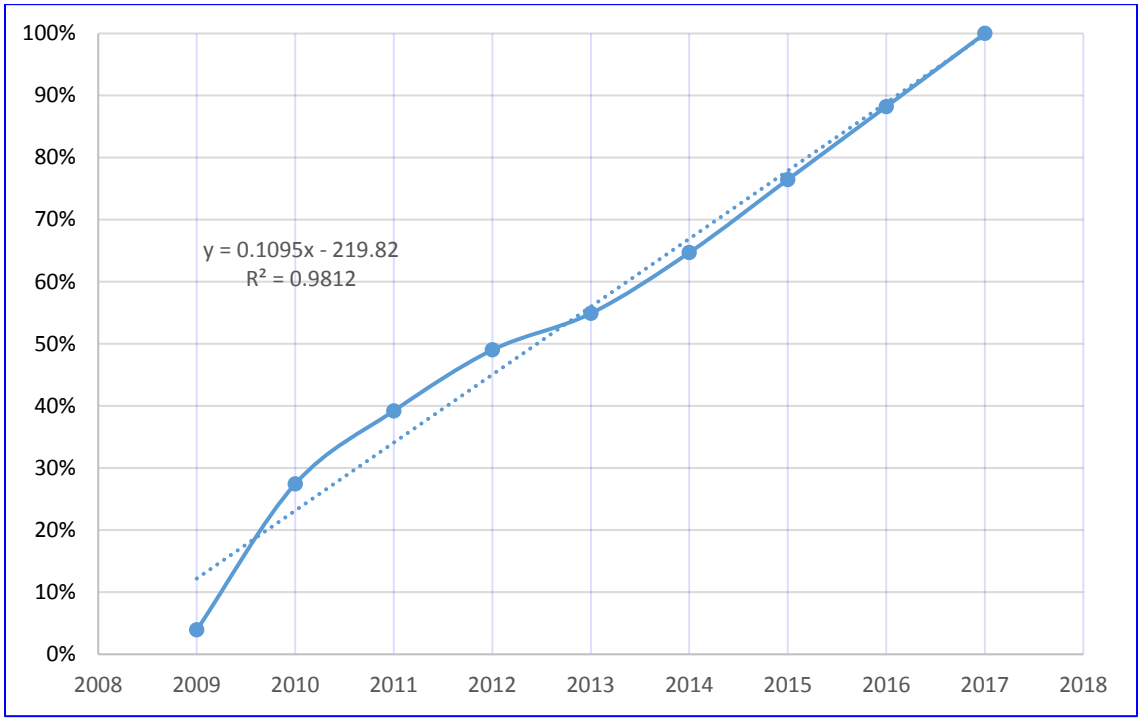


Figure 2 – Residential 2009 IECC National Adoption Rate

[6] U.S. Department of Energy, Pacific Northwest National Laboratory, *Building Energy Codes Program: National Benefits Assessment*, *1992-2040*, (March 2014).

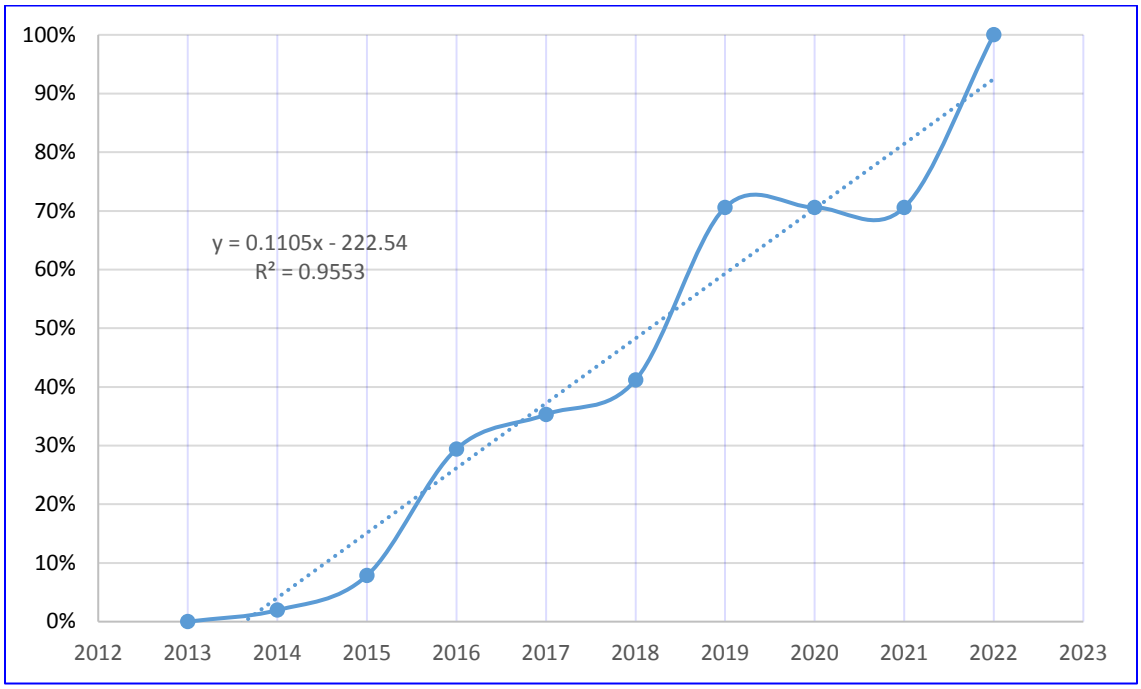


Figure 3 – Commercial ASHRAE Standard 90.1-2013 National Adoption Rate

CODE COMPLIANCE

Definition

The code compliance rate describes the average level of compliance that states in a given U.S. Census division have met compared with baseline energy code requirements (residential or commercial) over time. For example, the compliance rate of the 2009 IECC residential code is determined by tracking the rate at which states nationwide have complied with this code (or another code of equal stringency). At the state level, compliance is the average percent of energy code requirements met, weighted by energy impact, and verified through a formal compliance study. This definition was chosen for consistency with the approach used by U.S. Department of Energy's (DOE) Building Energy Code Program in the 90% Compliance Pilot Studies[7] for calculating state-level code compliance.

Research

Energy code compliance rates are difficult to attain. Enforcement of building energy codes has traditionally been performed at the jurisdiction level within each state, while code adoption rates vary across these same jurisdictions. The enforcement process includes building permitting, inspection, and sometimes performance testing processes, which may be implemented through either first-party, second-party, or third-party code officials. These officials must have the resources to assess compliance throughout each step of the process and the ability to navigate codes and standards that provide alternatives for achieving compliance, such as prescriptive, tradeoff, or performance paths. States may also be using older model codes, state-specific codes, and/or variations of codes with state amendments that provide additional challenges for assessing compliance in a consistent framework. Several anecdotally reviewed sources link code compliance to availability of sufficient resources, training, and education for code officials and market actors. The complexity of energy codes and frequency of code cycles provides an ongoing enforcement challenge for states and jurisdictions. The breadth and depth of energy code compliance can confound the data collection process and the quantification of compliance rates.

ICF identified two recently conducted studies that are relevant within this scope of work: DOE Building Energy Code Program, 90% Compliance Study, and DOE Residential Energy Field Study:

- DOE Building Energy Code Program, 90% Compliance Study This study documented new construction for both the residential and commercial building sectors in a select number of states. Renovation projects were assessed, but ICF determined these to be statistically invalid by the study authors and were therefore not reported. The studies were conducted to assist states in developing baseline compliance studies in response to ARRA 2009 funding requirements, which required states to achieve 90% compliance with 2009 IECC and ASHRAE Standard 90.1-2007 (or newer codes) by 2017.

[7] U.S. Department of Energy, 90% *Compliance Pilot Studies*, Final Report (June 2013).

- DOE Residential Energy Field Study This study documented code compliance in residential new construction for a select number of states, verified through onsite field inspections. Preliminary data was available for several building end-use characteristics that are relevant to code and sensitive to home energy consumption. Many of the states, however, had not yet published their final results, and sufficient data had not been collected to validate full compliance of a single home.

The DOE Building Energy Code Program 90% Compliance Study provided the most relevant state compliance data for use in this study. Each state compliance study was conducted within the last 10 years, performed using an established methodology developed by DOE, and performed for the same purpose. Compliance rates were determined by the relative number of energy code requirements met, and were weighted with respect to their energy impact. Despite consistent methodologies and framework established by DOE, the study implementation and reporting were not always consistent. The studies were conducted with varying levels of statistical and analytical rigor due to unique state energy code requirements resource constraints and timing requirements; this resulted in inconsistent reporting and results between the states. Similarly, states assessed compliance based on the codes enforced in their participating jurisdictions, using small sample sizes and introducing potential for bias error. These studies, nonetheless, represent the most recent and relevant collection of compliance studies and serve as a basis for ICF's work.

ICF identified several other state baseline and code compliance studies in the literature research. Many of these studies are older, use varying data collection approaches, and are performed for purposes other than state-wide code compliance (such as for energy efficiency program design). Other state-level studies provided details on energy code compliance at the measure- and component-levels and were not relevant to this study. Other studies forecasted energy savings and economic potential achievable through energy code compliance, while another study provided a meta-analysis of compliance studies. That study concluded there was insufficient information to quantify state compliance rates with any reasonable level of certainty.

Analysis

ICF obtained existing state compliance studies from the Building Code Assistance Project (BCAP) and Online Code Environment and Advocacy Network (OCEAN) websites. Emphasis was placed on studies completed since 2010 and those conducted under DOE Building Energy Code Program 90% compliance grant. State residential and commercial rates were collected and catalogued in a data model and grouped into three bins representing tiers of compliance. There were a total of 9 states that resulted in 6 residential and 6 commercial relevant studies.

ICF obtained compliance scoring data from the American Council for an Energy Efficient Economy's (ACEEE) 2015 State Energy Scorecard, whose data was similarly binned into the data model. When compliance rates were readily available from the states' compliance reports, ICF cataloged that data. When state compliance rates were unknown, their compliance rate were calculated using the straight average compliance rate with the bin corresponding to the state's ACEEE compliance score. The same methodology was used to assign the dates when the compliance rate was applicable. Annual compliance rate increases were assigned to each of the bins assuming that states with lower compliance rates had more room for improvement; their compliance levels could thereby increase at a faster rate than states with already higher compliance rates. Each state was capped at a maximum compliance rate of 90%.

Figure 4 and **Figure 5** illustrate the projected national residential and commercial model energy code compliance rates, respectively. The rates are forecasted from their baseline year until 90% compliance has been reached by all states at some future year. Forecasted compliance rates by U.S. Census division are provided **Appendix C**.

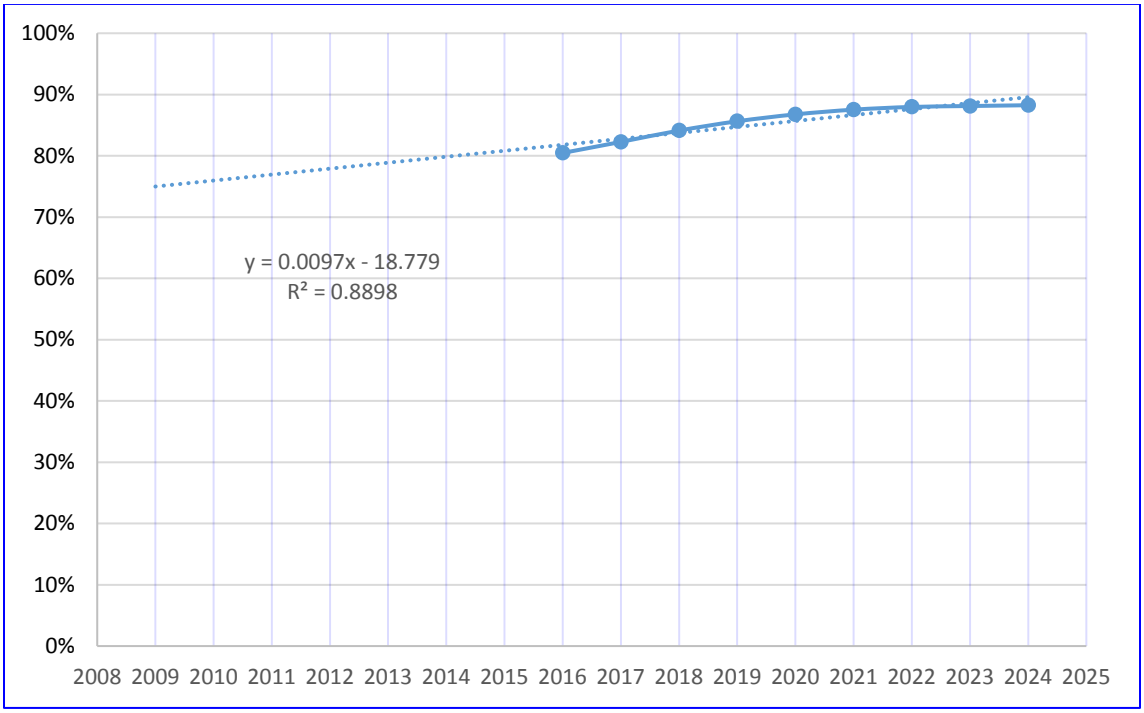


Figure 4 – Residential 2009 IECC National Compliance Rate

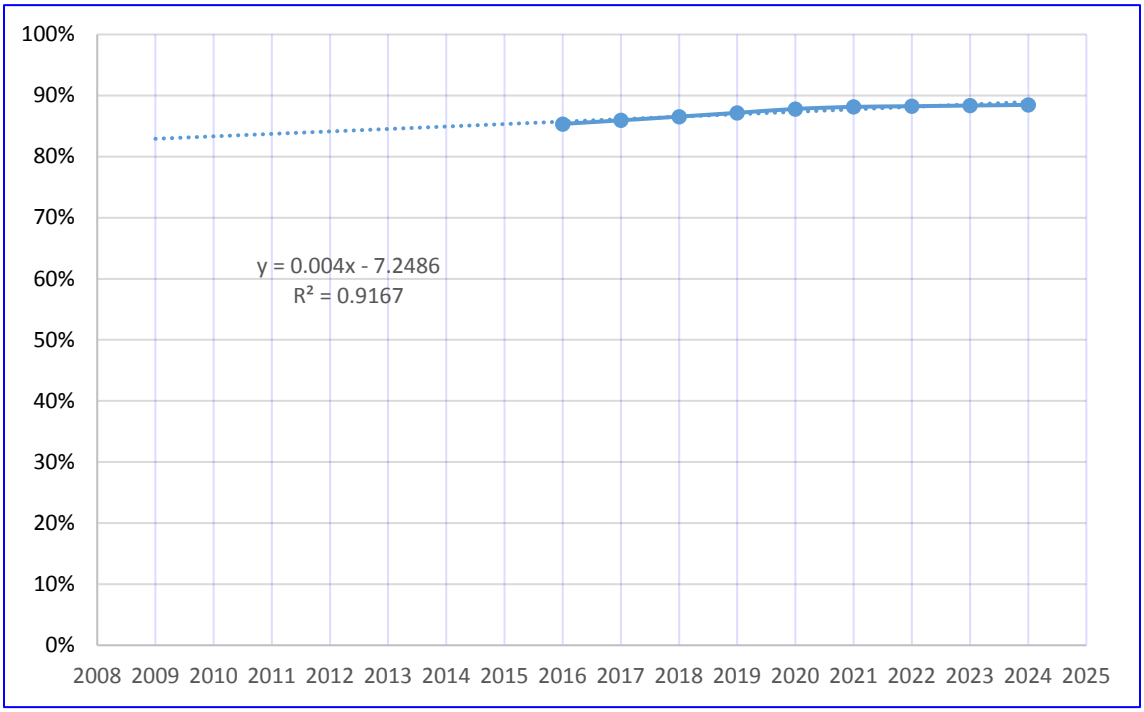


Figure 5 – Commercial ASHRAE Standard 90.1-2013 National Compliance Rate

OUTCOMES AND FINDINGS

There are several publicly available resources that provide data on state-level code adoption. Actual code adoption rates are complicated, however, due to state-specific amendments, home rule states, adoption timing, the version of code adopted, and the extent to which different jurisdictions choose to adopt the code.

The analysis estimates that at the national level, states will reach 100% compliance with 2009 IECC (or equivalent) by 2017 and 100% compliance with ASHRAE 90.1-2007 (or equivalent) by 2022. These results suggest that states will not reach 90% compliance with these model codes by 2017 as required by the ARRA 2009 funding requirements. At the U.S. Census division, the results suggests there are regional areas, such as New England, where adoption of newer, more efficient energy codes is more common. The results of this analysis may be improved by a better understanding of code adoption across state jurisdictions and by weighting those adoption rates by construction activity before aggregating to the U.S. Census division.

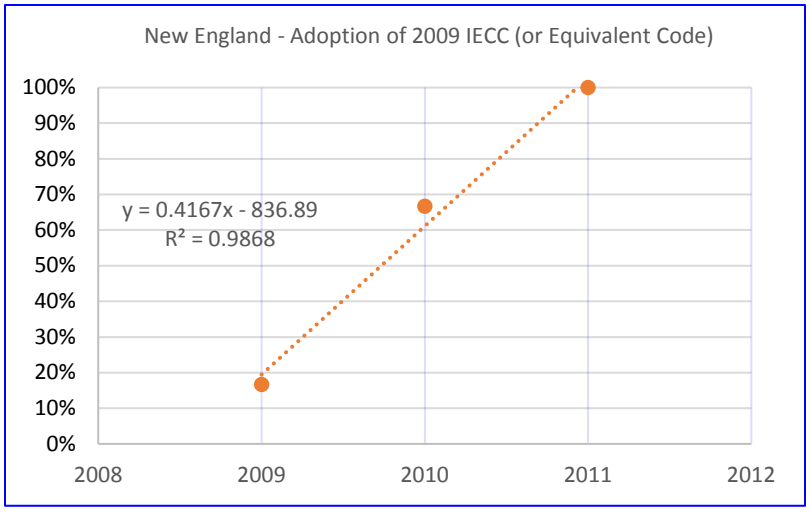
State-level compliance is complicated by a lack of uniformity in code adoption and the nuanced complexity of building energy codes. The analysis estimates that at the national level, states will reach 90% compliance with 2009 IECC and ASHRAE 90.1-2007 (or equivalent) by 2025, and most states will not meet the 90% compliance requirements stipulated by ARRA 2009 funding. At both the national level and U.S. Census division, the results suggest already high rates of compliance and a steady year-by-year improvement in compliance rates. The strong correlation and trend exhibited in the compliance data is a direct result of assumptions that underlie the analysis due to insufficient state-level compliance data. As more states perform compliance studies and those states report compliance on an annual basis, compliance assumptions will become more consistent and may be more accurately forecasted.

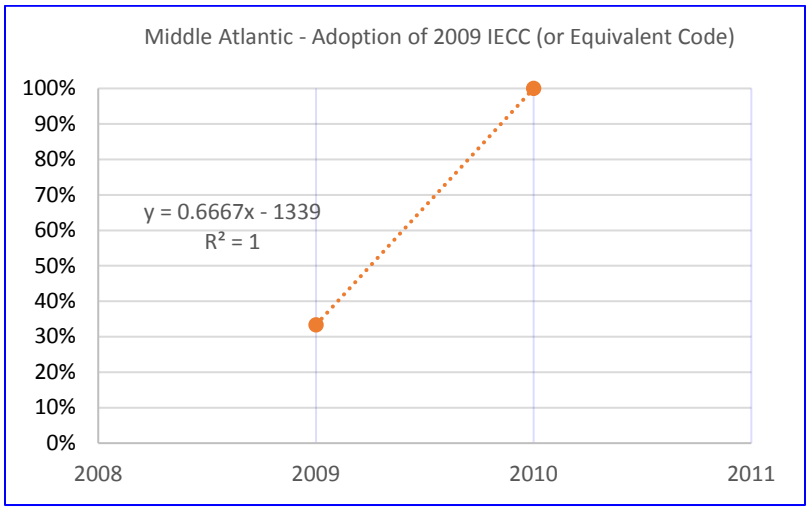
APPENDIX A – Resources

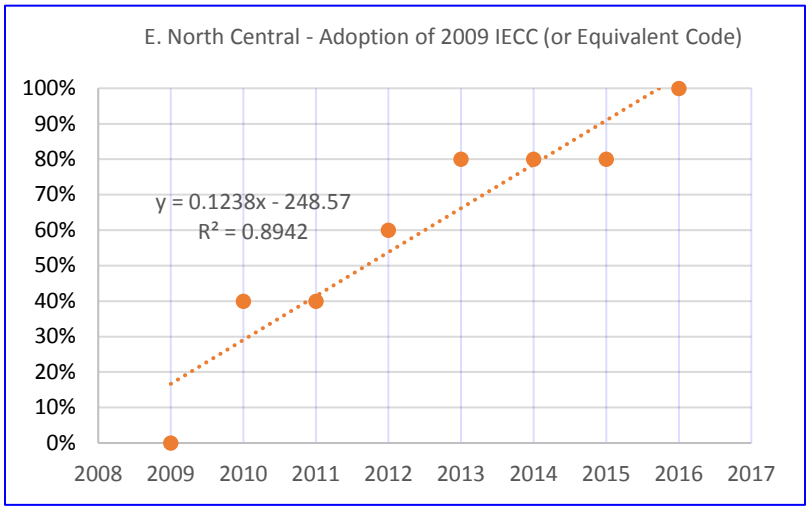
- Institute for Market Transformation "Assessment of Energy Efficiency Achievable from Improved Compliance with US Building Energy Codes: 2013-2030" (February 2013); [online] Available at: http://www.imt.org/uploads/resources/files/IMT_Report_Code_Compliance_Savings_Potential_FINAL_2013-5-2.pdf
- Alliance to Save Energy "The Compliance Planning Assistance Program" [online] Available at: https://www.ase.org/sites/ase.org/files/cpa_white_paper.pdf
- American Council for Energy-Efficient Economy "The 2015 State Energy Efficiency Scorecard" (October 2015); [online] Available at: http://www.ourenergypolicy.org/wp-content/uploads/2015/10/u1509.pdf
- Institute for Market Transformation , US Green Building Council, Building Codes Assistance Project, B&F Technical Code Services, City of Gillette Wyoming "Successful Strategies for Improving Compliance with Building Energy Codes," *2012 ACEEE Summer Study*; [online] Available at: http://aceee.org/files/proceedings/2012/data/papers/0193-000112.pdf
- Pacific Northwest National Laboratory "Building Energy Codes Program: National Benefits Assessment, 1992 – 2040" (March 2014); [online] Available at: https://www.energycodes.gov/sites/default/files/documents/BenefitsReport_Final_March20142.pdf
- U.S. Department of Energy Technical Assistance Program "Policies and Procedures for Enhancing Code Compliance" (May 31, 2011); [online] Available at: http://www1.eere.energy.gov/wip/solutioncenter/pdfs/Policies%20and%20Procedures%20for%20Enhancing%20Code%20Compliance.pdf
- Building Energy Codes Program "Building Technologies Peer Review" (April 2014); [online] Available at: http://energy.gov/sites/prod/files/2014/05/f15/Program_Overview_Williams_042214.pdf
- U.S. Department of Energy Building Technologies Program "Current Activities in Support of Building Energy Codes" (March 2, 2012); [online] Available at: http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/energy_codes_support.pdf
- U.S. Department of Energy Building Energy Codes Program "Single Family Residential Energy Code Field Study; DOE's Residential Field Study webinar" (December 7, 2015); [online] Available at: https://www.energycodes.gov/sites/default/files/documents/Field_Study_120715_Final.pdf
- U.S. Department of Energy "90% Compliance Pilot Studies Final Report" (June 2013); [online] Available at: https://www.energycodes.gov/sites/default/files/documents/Compliance%20Pilot%20Studies%20Final%20Report.pdf
- Pacific Northwest National Laboratory "Roadmap for the Future of Commercial Energy Codes" (January 2015); [online] Available at: http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24009.pdf

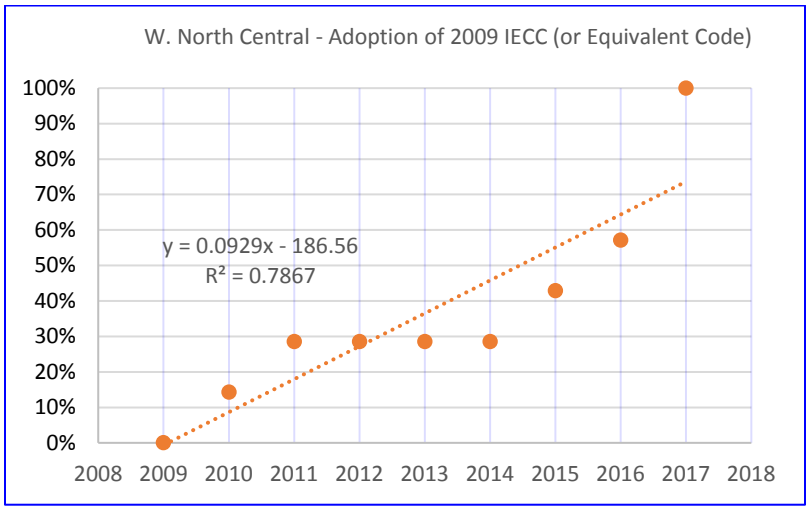
APPENDIX B – Adoption Rates by U.S. Census Division

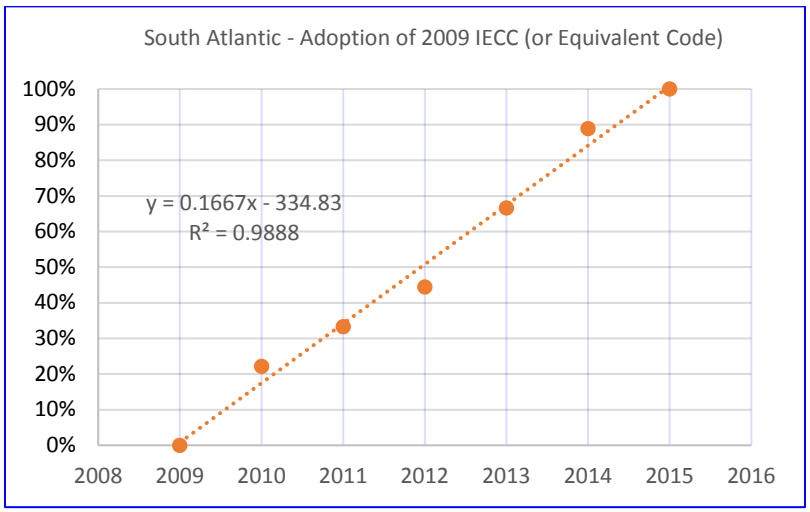
Residential

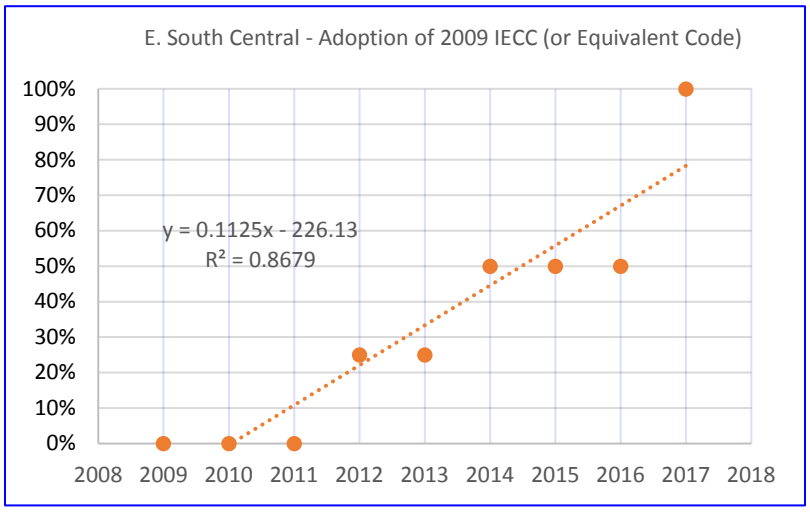


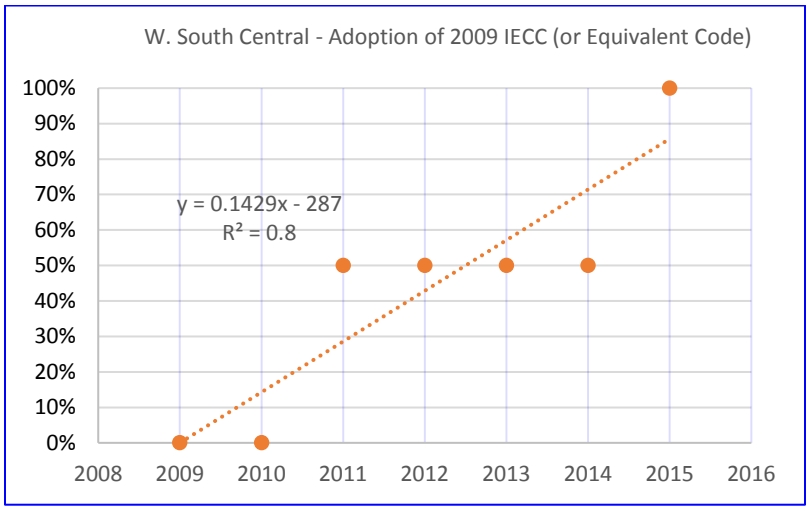


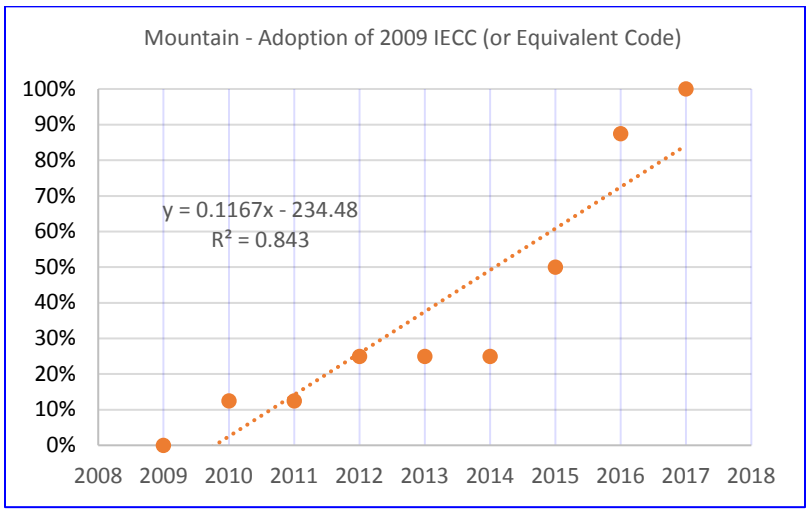


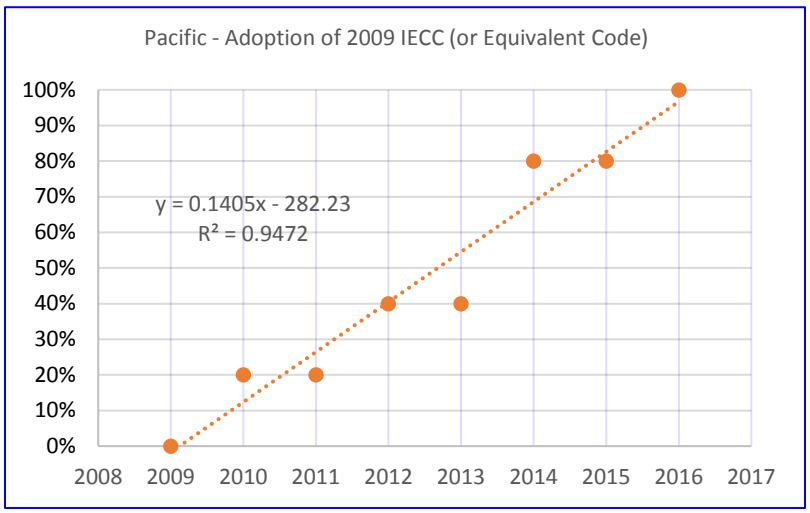

W. North Central - Adoption of 2009 IECC (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0929x - 186.56
R² = 0.7867
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018


South Atlantic - Adoption of 2009 IECC (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.1667x - 334.83
R² = 0.9888
2008 2009 2010 2011 2012 2013 2014 2015 2016

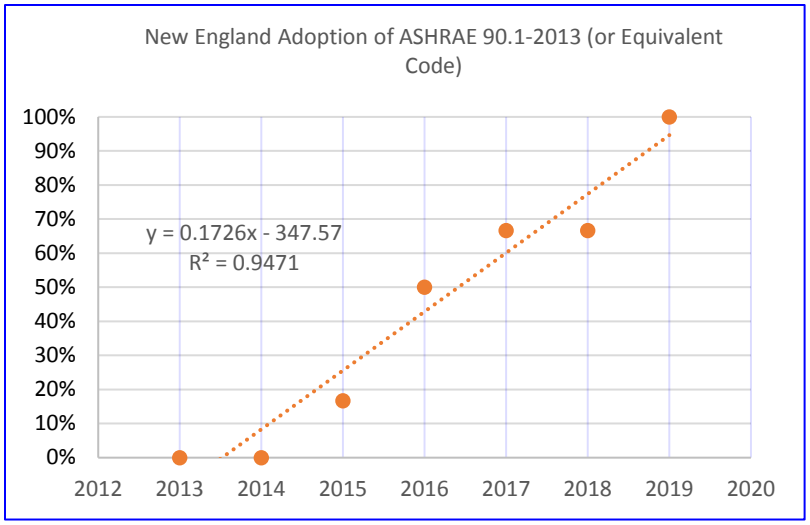

E. South Central - Adoption of 2009 IECC (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.1125x - 226.13
R² = 0.8679
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

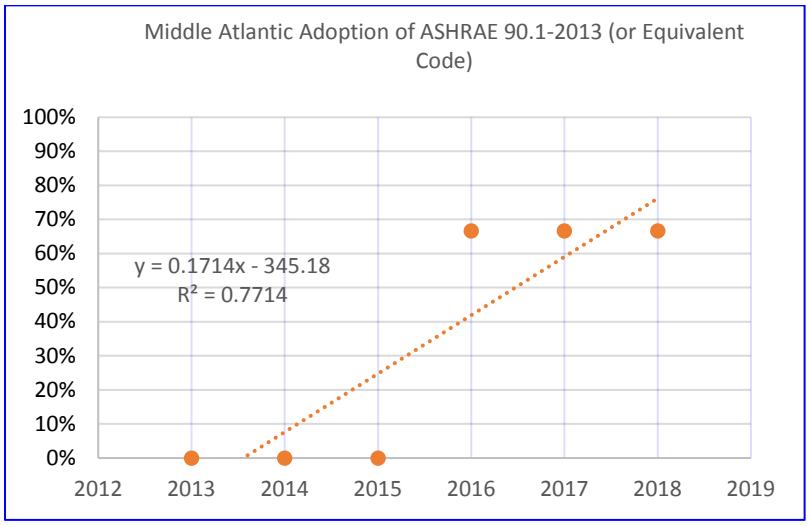

W. South Central - Adoption of 2009 IECC (or Equivalent Code)
y = 0.1429x - 287
R² = 0.8
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
2009
2010
2011
2012
2013
2014
2015
2016

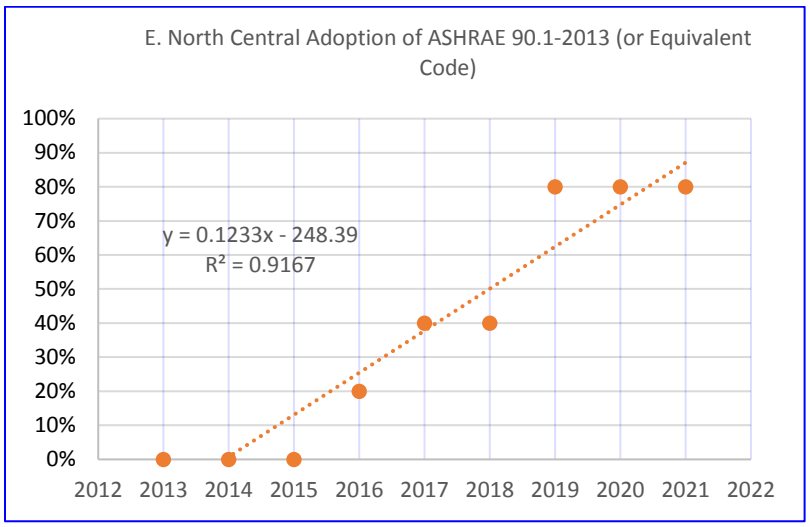

Mountain - Adoption of 2009 IECC (or Equivalent Code)
y = 0.1167x - 234.48
R² = 0.843
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

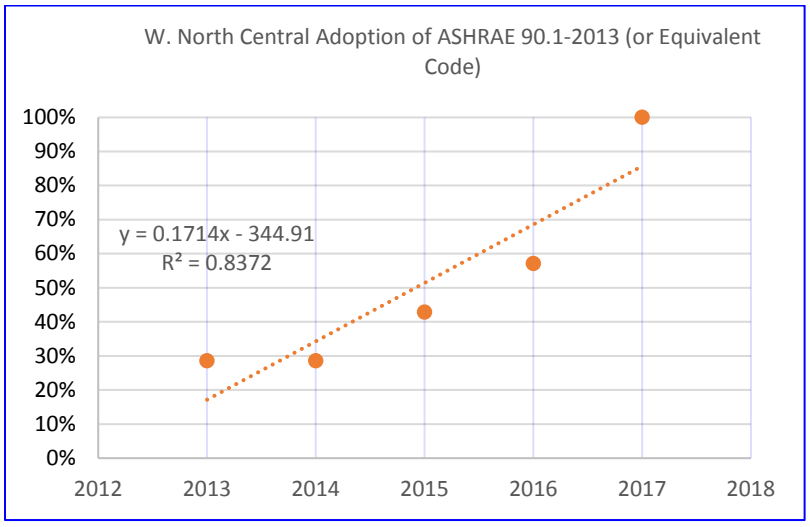

Pacific - Adoption of 2009 IECC (or Equivalent Code)
y = 0.1405x - 282.23
R² = 0.9472
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

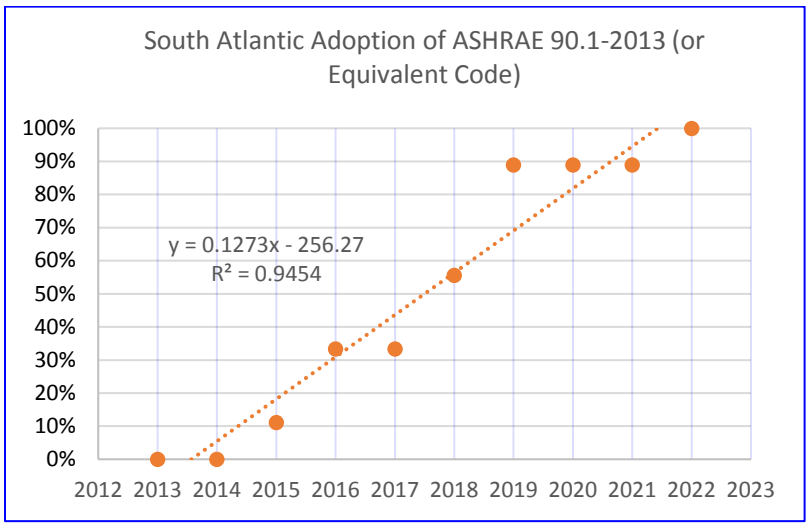
Commercial

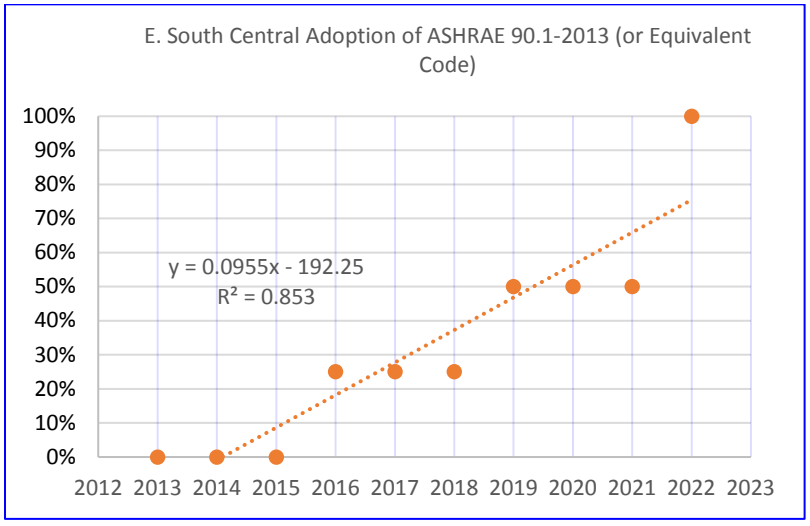

New England Adoption of ASHRAE 90.1-2013 (or Equivalent Code)
y = 0.1726x - 347.57
R² = 0.9471
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2012
2013
2014
2015
2016
2017
2018
2019
2020

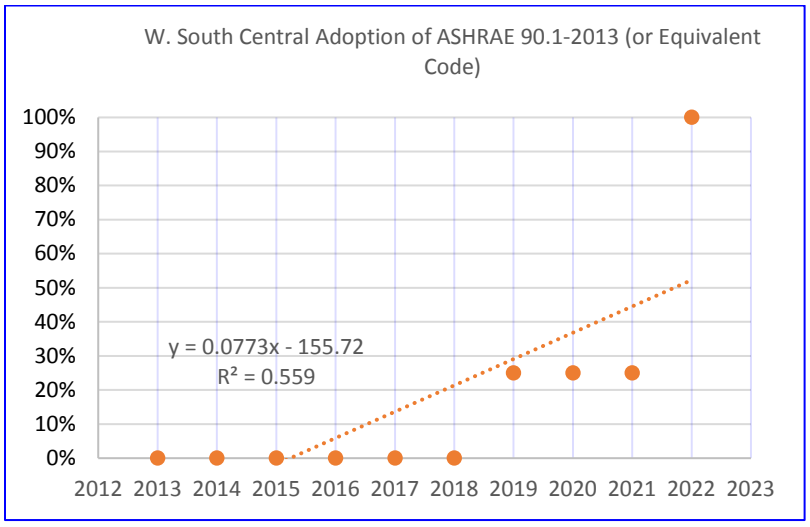

Middle Atlantic Adoption of ASHRAE 90.1-2013 (or Equivalent Code)
y = 0.1714x - 345.18
R² = 0.7714
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2012
2013
2014
2015
2016
2017
2018
2019

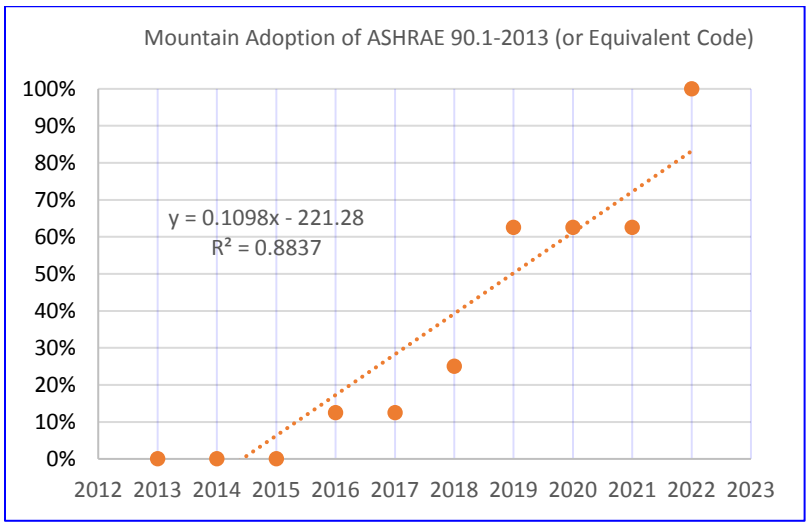

E. North Central Adoption of ASHRAE 90.1-2013 (or Equivalent Code)
y = 0.1233x - 248.39
R² = 0.9167
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

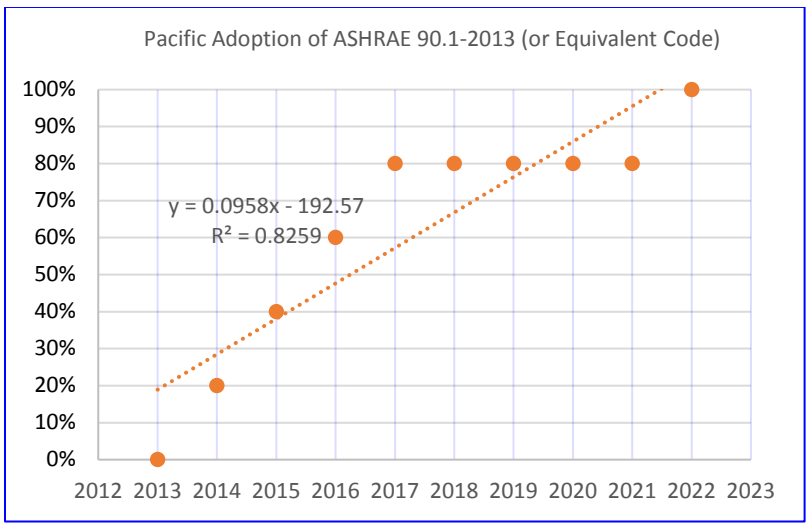

W. North Central Adoption of ASHRAE 90.1-2013 (or Equivalent Code)
y = 0.1714x - 344.91
R² = 0.8372
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2012
2013
2014
2015
2016
2017
2018


South Atlantic Adoption of ASHRAE 90.1-2013 (or Equivalent Code)
y = 0.1273x - 256.27
R² = 0.9454
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023


E. South Central Adoption of ASHRAE 90.1-2013 (or Equivalent Code)
y = 0.0955x - 192.25
R² = 0.853
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

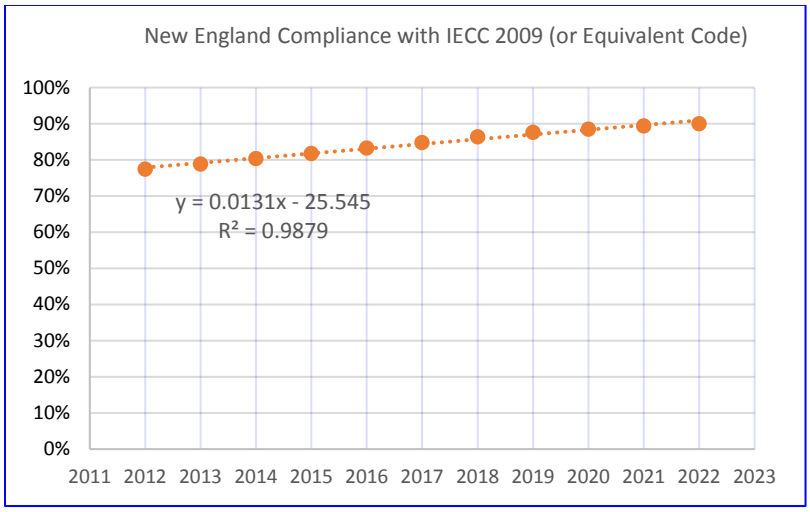

W. South Central Adoption of ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0773x - 155.72
R² = 0.559
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

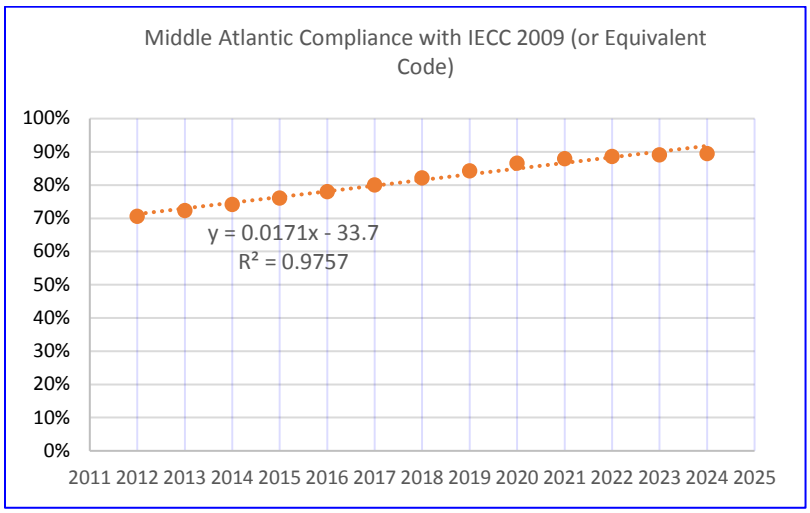

Mountain Adoption of ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.1098x - 221.28
R² = 0.8837
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

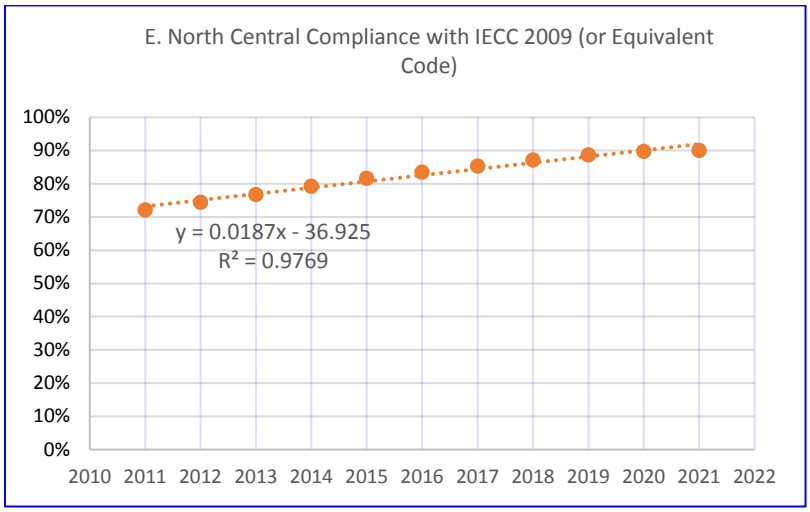

Pacific Adoption of ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0958x - 192.57
R² = 0.8259
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

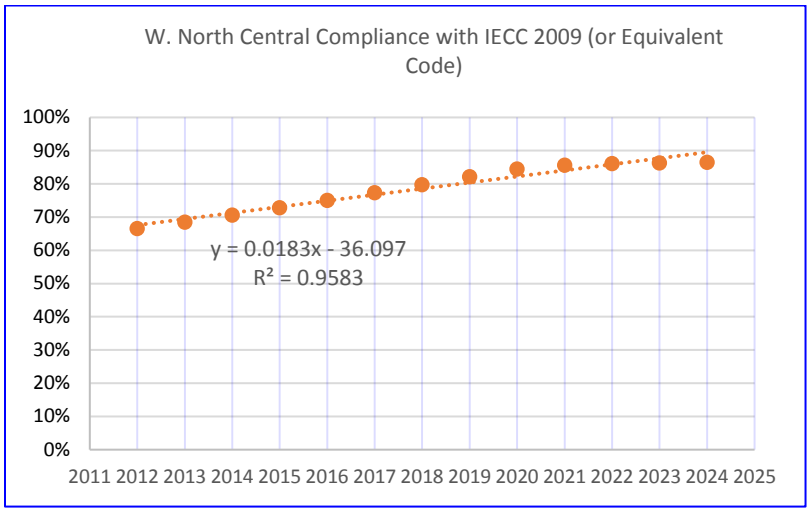
APPENDIX C – Compliance Rates by U.S. Census Division

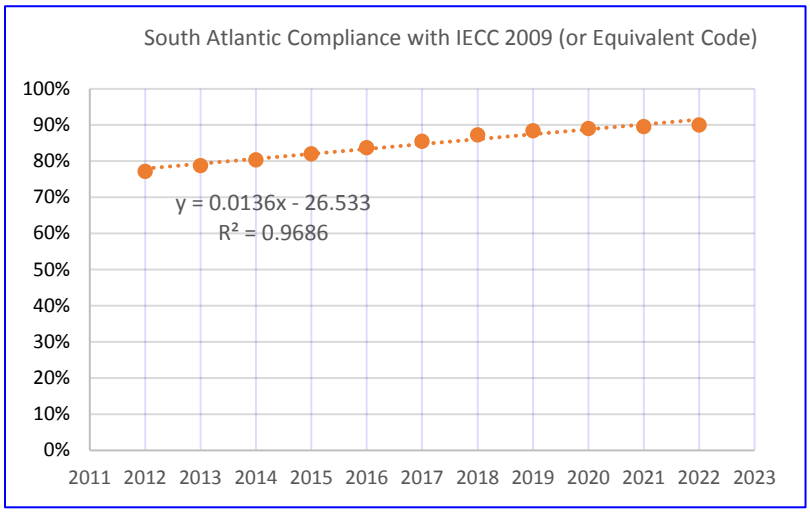
Residential

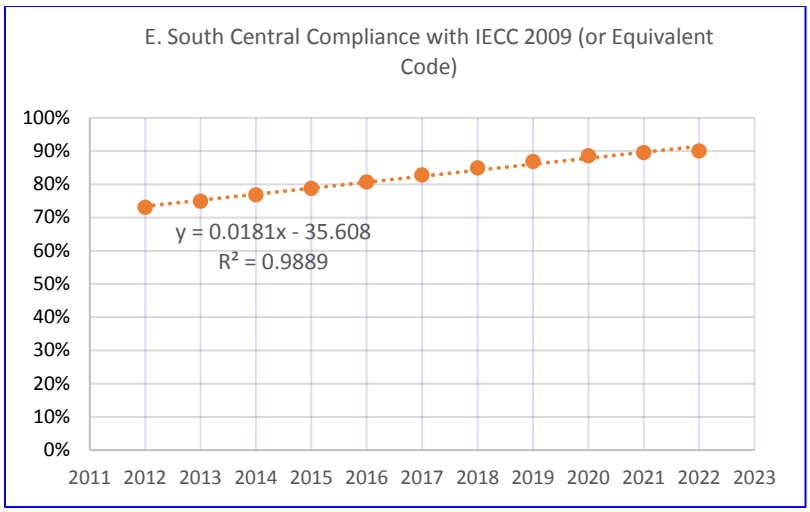


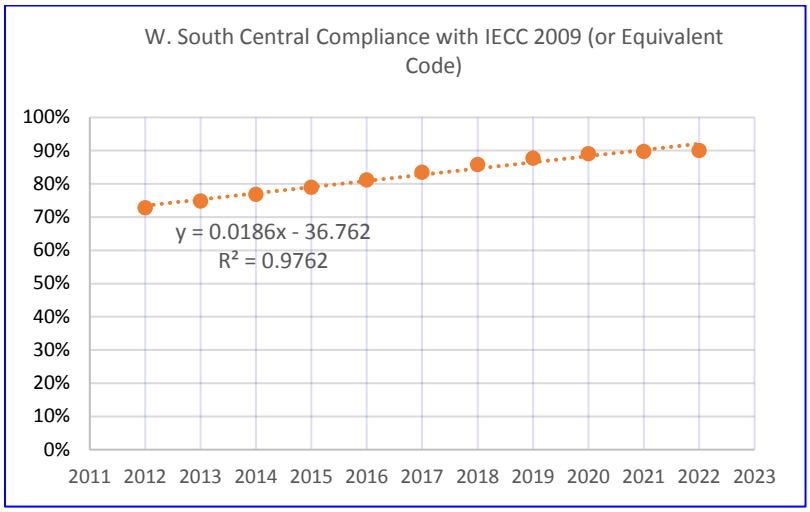


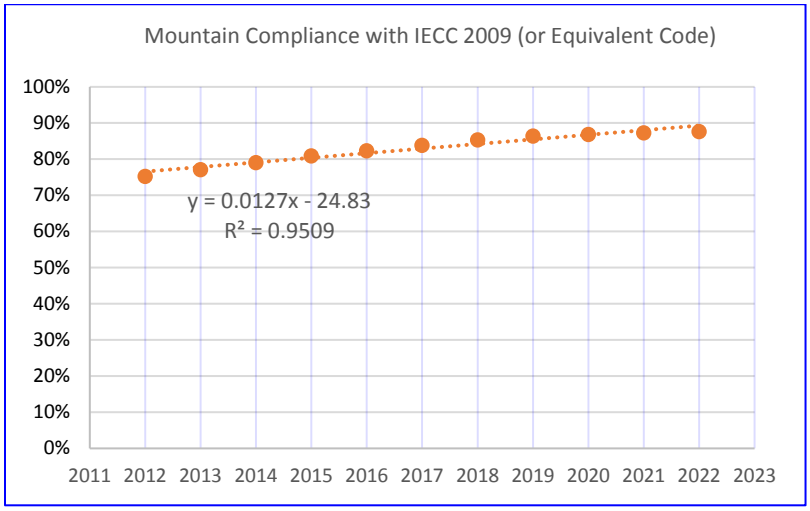


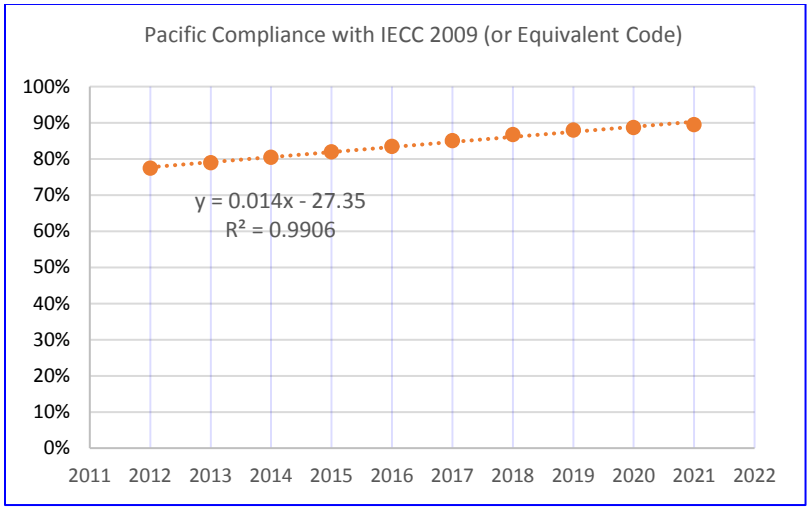

W. North Central Compliance with IECC 2009 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0183x - 36.097
R² = 0.9583
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025


South Atlantic Compliance with IECC 2009 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0136x - 26.533
R² = 0.9686
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

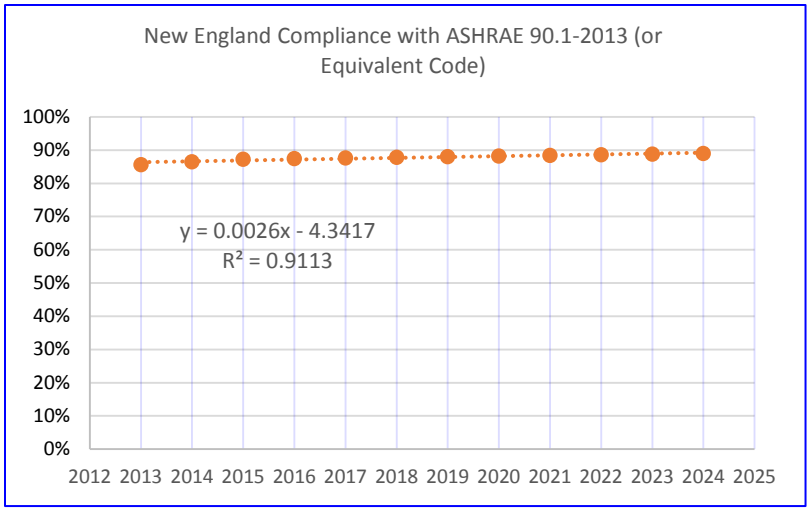

E. South Central Compliance with IECC 2009 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0181x - 35.608
R² = 0.9889
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

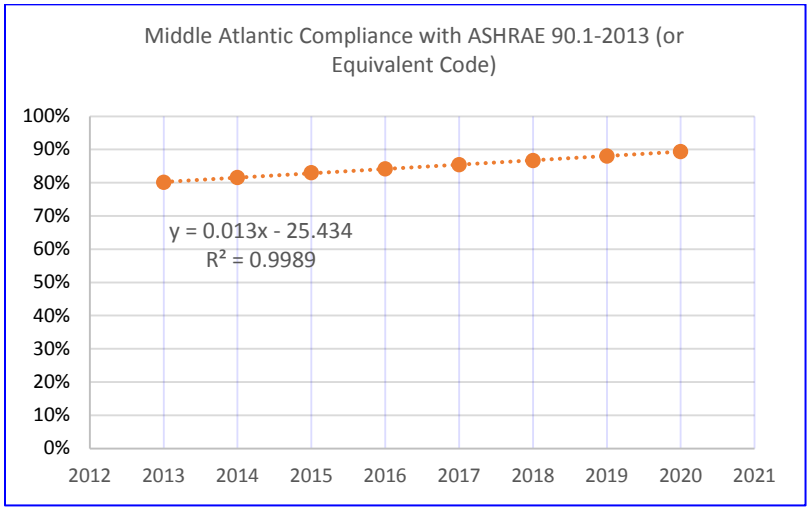

W. South Central Compliance with IECC 2009 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0186x - 36.762
R² = 0.9762
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

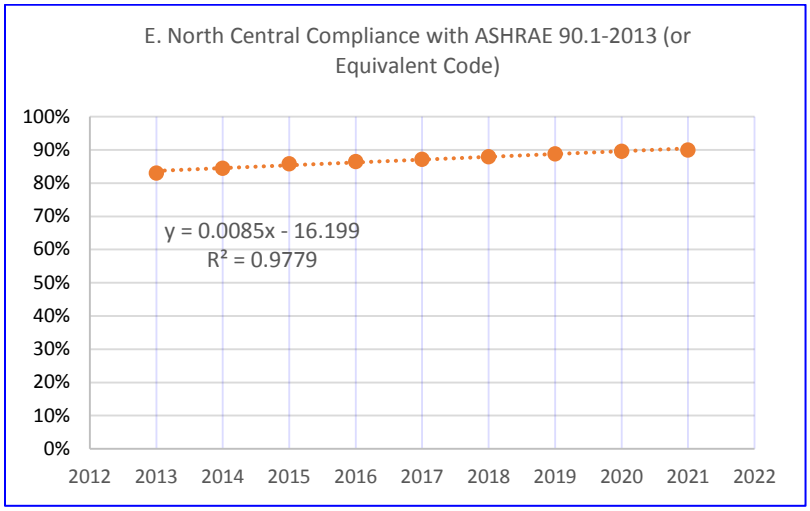

Mountain Compliance with IECC 2009 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0127x - 24.83
R² = 0.9509
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023

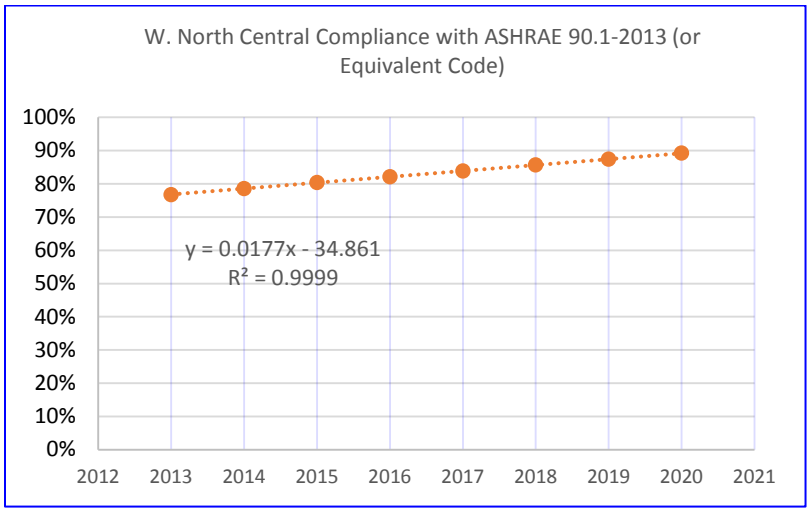

Pacific Compliance with IECC 2009 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.014x - 27.35
R² = 0.9906
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

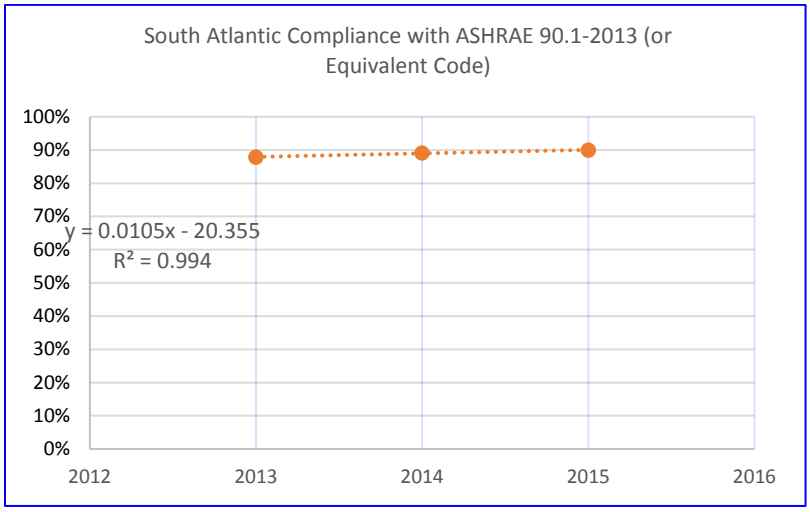
Commercial

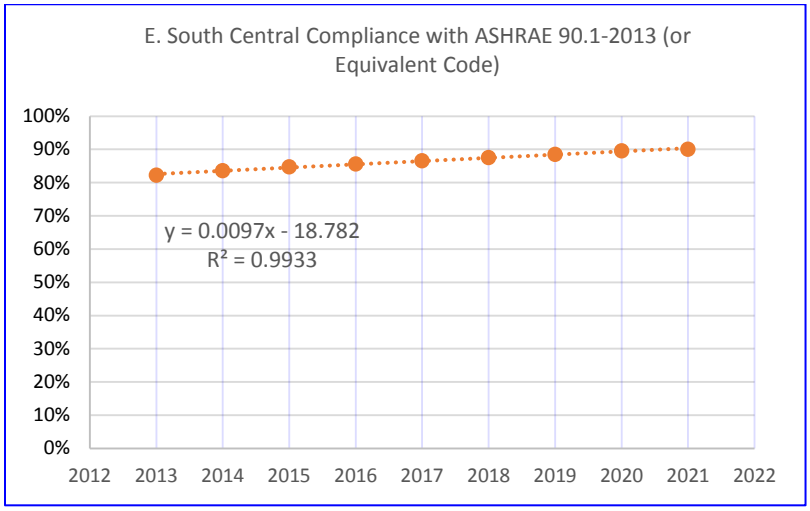

New England Compliance with ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0026x - 4.3417
R² = 0.9113
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

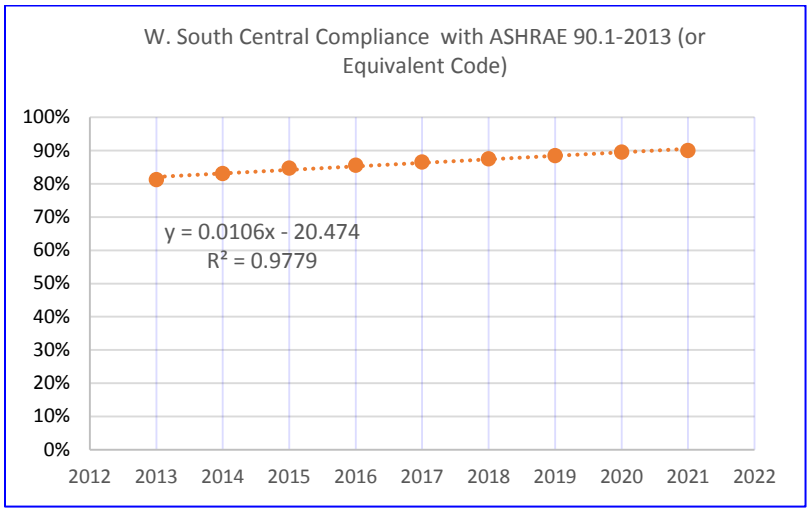

Middle Atlantic Compliance with ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.013x - 25.434
R² = 0.9989
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

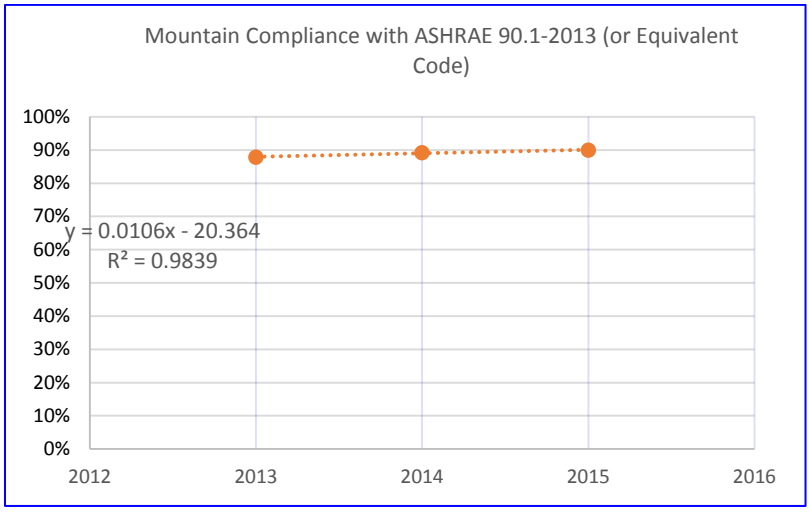

E. North Central Compliance with ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0085x - 16.199
R² = 0.9779
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

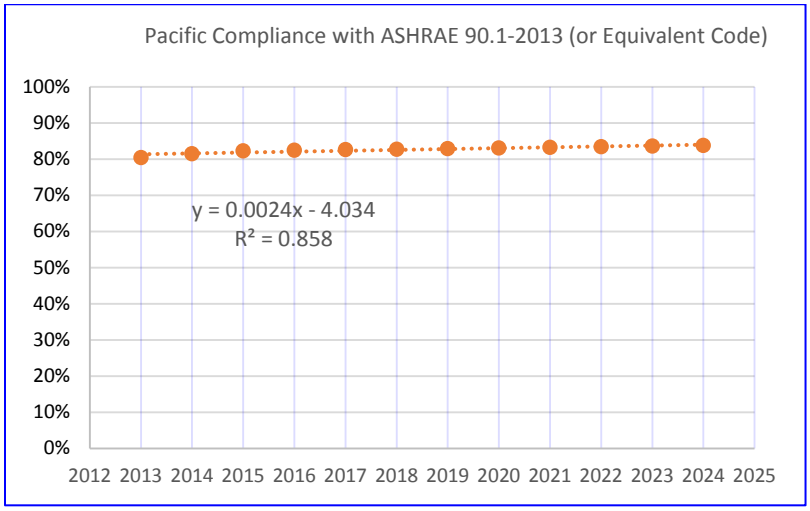

W. North Central Compliance with ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0177x - 34.861
R² = 0.9999
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021


South Atlantic Compliance with ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0105x - 20.355
R² = 0.994
2012
2013
2014
2015
2016


E. South Central Compliance with ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0097x - 18.782
R² = 0.9933
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022


W. South Central Compliance with ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0106x - 20.474
R² = 0.9779
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


Mountain Compliance with ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0106x - 20.364
R² = 0.9839
2012 2013 2014 2015 2016


Pacific Compliance with ASHRAE 90.1-2013 (or Equivalent Code)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
y = 0.0024x - 4.034
R² = 0.858
2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

PASSION. EXPERTISE. RESULTS.