Codes & Standards: A View from the Shores of Hawaii[1]

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ABSTRACT

Hawaii strives to reduce electricity use by 4,300 GWh by 2030. Based on the state's recent energy efficiency potential study, this will come in part from existing codes, in part from natural market changes, and in part from the support of ratepayer-based programs and other activities. Given the state's aggressive goals, it is important to capture savings from all of those sources.

In recent years, California has leveraged its ratepayer-based programs to support codes and standards—increasing program savings by 25%. Even small states such as Rhode Island have found savings opportunities from the support of codes and standards. Do these opportunities exist for Hawaii and other states across the country? What implementation models are effective and make sense from a program implementation perspective?

This paper discusses the status of energy codes in Hawaii, estimates potential savings from code-related activities in Hawaii, and provides key takeaways for both Hawaii and other states based on a review of three states that are currently supporting codes and standards activities.

Introduction

The State of Hawaii Public Utilities Commission (PUC) contracts with a third party to offer energy efficiency programs in the Hawaiian Electric Companies' service territories under the brand name "Hawaii Energy."[2,3] Given the state's aggressive energy efficiency goals, it is important to identify and capture savings from a wide variety of sources, including building codes and appliance/equipment standards that reduce energy use. One such opportunity lies in strengthening Hawaii's building energy codes and appliance/equipment standards. This paper is based on an initial review on behalf of the PUC to try to understand opportunities for energy savings from codes and standards activities in Hawaii, and what role the Hawaii Energy

[1] This paper represents the independent work of the authors, not the official positions of any other organization, regulatory or governmental agency.
[2] http://www.hawaiienergy.com
[3]Hawaii Energy is a ratepayer-funded conservation and efficiency program administered by Leidos Engineering, LLC under contract with the Hawaii Public Utilities Commission (PUC) as the Public Benefits Fee Administrator (PBFA) serving the islands of Hawaii, Lanai, Maui, Molokai and Oahu. PBFA activities are funded by a bill surcharge, the "Public Benefits Fee." On July 1, 2009, Hawaii Energy took over management of the demand side management programs from Hawaiian Electric Company (HECO) and its subsidiaries, Maui Electric Company (MECO) and Hawaii Electric Light Company (HELCO) https://www.hawaiianelectric.com/ . Kauai is served by its own utility, Kauai Island Utility Cooperative (KIUC) http://website.kiuc.coop/. KIUC operates its own programs and does not participate in the PBF, although energy savings from the KIUC programs do contribute to statewide goals.

programs might be able play in achieving these savings. This initial analysis focused mainly on building codes for new construction. However, we note that codes affecting major renovations and appliance/equipment standards are also important sources for energy savings in Hawaii. The PUC intends to conduct additional analyses to better understand these opportunities as well.

In this paper, we summarize Hawaii's history with energy codes and describe how three comparison states utilize ratepayer programs to support new building codes. The three comparison states were selected to provide a broad range of information (i.e., various sizes, various types of savings, etc.). We included the largest and most well-known example (California) as well as two other smaller jurisdictions (Arizona and Rhode Island) that offered alternative models. Based on the review of these three states, we provide recommendations for Hawaii, as well as key takeaways for other states that are seeking opportunities for leveraging energy efficiency programs to support codes and standards that reduce energy use.

Mamua[4]: Hawaii's Unique Building Code History and Landscape

Hawaii is a national leader in support for clean energy and energy efficiency. However, compared to other states, Hawaii has been slow to adopt new building energy codes. In 2010, the governor signed the 2006 International Energy Conservation Code (2006 IECC) into law. As of May 2016 (the writing of this paper) the 2006 IECC remains the approved "current" code in Honolulu, Maui, and Hawaii counties despite the fact that the International Code Council put forth new model energy codes in 2009, 2012 and 2015. In other words, Hawaii's statewide building code is three cycles behind IECC recommendations.

Table 1. Current codes by jurisdiction in Hawaii and date of approval

County				State
Honolulu	Maui	Hawaii	Kauai	State of Hawaii
2006 IECC	2006 IECC	2006 IECC	2009 IECC	2006 IECC
Adopted November 2009	December 2009	October 2010	May 2010	Effective 2012

Data from the Hawaii Energy website, as borrowed from Gaur Johnson, Structural Engineers Association of Hawaii. www.hawaiienergy.com

The process of adopting new building codes in Hawaii starts with the Hawaii State Building Code Council, currently a 12-member group including representatives of each county, as well as members of the building industry. Once the State Building Code Council approves a model energy code, to become fully adopted and enforced by the state, an "Administrative Rule" must be drafted and sent for review by key state officials before going to public hearings and then being signed by the governor. There is also an alternative path by which energy codes can be approved locally. Counties in Hawaii can propose and approve their own energy codes through a "County Path" as long as they at least meet the requirements of the most recent state codes.

As such, adoption is a two-stage process (first approval by the State Building Code Council and then full adoption) and also has two alternative paths (or "prongs") by which full adoption can occur, i.e., through adoption by the governor, or adoption by the counties.

Through this two-stage process, there is a history of support for new codes, but also a lack of full adoption. In the past, the State Buildings Code Council supported the 2009 IECC,

[4] "prior" or "before"

and the State of Hawaii Department of Business, Economic Development and Tourism (DBEDT) trained a large number of builders on the 2009 code. However, the State Building Code Council encountered barriers and lacked the resources to get the 2009 code adopted by either the state or counties other than Kauai. According to the 2013 and 2014 Annual Reports by the State Building Code Council, "The Council's adoption of recent versions of the model building codes [at the state level] are delayed as resources are needed to draft the administrative rules and to carry out the steps required to have the administrative rules adopted. Also the Department of Accounting and General Services no longer provides administrative support [to the Council]. As a result, the work the Council has done to adopt amendments for new versions of the model building codes cannot be adopted and implemented as there is no administrative rule." (Hawaii DAGS 2014). Similarly, gaining support for adopting new codes has been challenging at the county level.

There are, however, indications that this situation may be changing. Some stakeholders have expressed interest in leapfrogging to the most recent National Codes (i.e., 2015 IECC). On July 15, 2015, the Statewide Building Code Council accepted and began promoting code that was equivalent to the 2015 level. Based on interviews conducted for this project, DBEDT staff anticipates that the counties could adopt as early as the summer of 2016. Given the prior track record, there may be administrative barriers and general lack of interest that prevent full acceptance. On the other hand, Hawaii's clean energy goals may invigorate stakeholders and allow the code adoption process to move more quickly. Hawaii Energy may be able to assist the process by leveraging program support.

Perspective on Three States: A View from Hawaii's Shores

In most states, as in Hawaii, state and local governments are responsible for code implementation. However, a number of states have begun to leverage utility-funded and/or other publicly funded energy efficiency programs to support development and implementation of building codes and appliance standards that save energy. We examined approaches in three states (summarized in Table 2), representing a broad range of activities and sizes, to better understand potential opportunities—and limitations—for employing these models in Hawaii. We also examined mechanisms the states have developed to enable the program administrators to support these activities, including allowing the programs to claim energy efficiency savings toward their annual goals.

California. Look! A Whale!

In California, the California Energy Commission (Energy Commission) is responsible for developing and publishing statewide building codes and appliance/equipment standards. However, the California PUC, which oversees the state's large investor-owned utilities (IOUs), has encouraged the utility-based, ratepayer-funded energy efficiency programs to support the Energy Commission's efforts. In turn, the utilities are able to allocate program administration funds for these activities, and to count some of the resulting energy savings toward their annual goals. Over the 2010-2012 period the IOUs claimed 2,203 GWh and 374 MW of peak reduction

overall from their Codes and Standards program—equal to about one quarter of the savings from all other programs in their portfolio during this same timeframe[5] (Cadmus and DNV-GL 2014).

The utility programs offer a variety of activities including technical analysis, case studies, market analysis, outreach, training and product lifecycle cost-effectiveness analysis.[6] This work informs the development of California (and sometimes federal) codes and standards.

There are opportunities to support codes and standards through important Hawaii-specific research similar to California's efforts. Key takeaways from the California experience include:

Emphasis on both appliance/equipment standards and building codes. Notably, the majority of the savings claimed by the California IOUs (more than three quarters) comes from appliance standards at the state and federal level. New buildings accounted for 583 GWh (about 26%) of all codes and standards savings claimed in the timeframe, and appliance-related standards made up the majority (74%) of savings.

Long-term perspective. The California example also demonstrates that these savings accumulate tremendously over time. The numbers above are just for the 2010-2012 period, and do not include the layering in of savings from earlier years. Codes and standards support represents an upfront cost for obtaining future savings, so regulators and program administrators may need to develop a satisfactory mechanism to reimburse program expenditures on code and standards support, bearing in mind that "first year" savings will be minimal.

Ability to influence code development. Most states across the country look to the International Code Council for guidance on state-level building codes. They either adopt the model building energy codes proposed by the International Code Council, or they modify the codes to account for unique state characteristics. Like Hawaii, local counties in California must comply with state regulations but have the option of adopting stretch or reach codes at the county level. California publishes its own, more stringent, Title 24 state building codes and Title 20 appliance and equipment efficiency regulations established by the Energy Commission. Due to its market size, California is able to exert some influence on even national code development (and the California PUC allows the utilities to count a portion of national savings toward their annual goals).[7] In terms of affecting the actual code *specifications*, the Hawaii Energy programs are likely to have more influence on local rather than national criteria. But influencing the final code specifications is only one aspect of the support energy efficiency programs are able to provide. Research, case-studies, training, outreach, tools and other activities are all important in ensuring that savings are realized.

Level of investment. California's level of investment (and effort) in this arena is significant. For the three year period 2010-2012, California invested $30 million in support for codes and standards. This is about 1.5 percent of the total portfolio budget, but accounted for close to 20 percent of the portfolio savings.

Number of new homes and buildings built. The number of new homes and buildings, and thus the potential for savings from code changes, is different in Hawaii. According to the DBEDT report, *Measuring Housing Demand in Hawaii, 2015-2025* (April 2015), approximately

[5] Savings from p. 95 of the report. The program as a whole, including building codes and appliance codes support, both state and federal, claimed 2,203 GWh and 374 MW (see abstract page vi). They also received therm savings, not discussed here. Savings were even higher if estimates included savings over 2005 and 2008 Title 24 building codes.

[6] See for example: http://energycodeace.com/

[7] Given its market size, Hawaii might not have as much influence on national standards as California, though it is still important to have Hawaii's perspective considered in the national discussions. And, by forming coalitions with other states, Hawaii can amplify its voice.

2,400 single-family units, and an additional, 700 multifamily units are built in Hawaii each year whereas California usually builds about 100,000 units (CA LAO 2015). The absolute value of savings from enhanced codes will be higher in California (due to the number of homes, home size, and high cooling loads), although both states have about the same rate of home building on a per capita basis as of 2013 (Deitz 2014).

While there are differences between Hawaii and California, California offers an example for states interested in fostering a high commitment to codes and standards, and leveraging ratepayer programs do so. This "whale" is something to watch.

Rhode Island: Broadening their Net.

From the shores of Hawaii, however, we can see that it's not just the big guys who are supporting codes and standards with their ratepayer-based programs. Even small states such as Rhode Island are actively pursuing savings opportunities. National Grid's programs in Rhode Island offer a suite of activities to support codes and standards including proactive outreach to key stakeholders and training for code officials, builders, architects, and other professionals. Their initial focus has been on increasing compliance, with the motto: "It's the right thing to do: we are the enabler, not the enforcer." The programs are able to count savings that arise from baseline compliance to "new" higher levels of compliance. Rhode Island claimed an estimated 3,550 MWh in 2014 (about 0.3% of their total portfolio). Because their savings come from compliance activities such as training buildings and raters, the applicability of this model (to other states) depends on the current rates of compliance (i.e., if compliance is high, the potential for savings based on increased compliance is low and vice versa).

Status of existing codes. Savings from compliance depends on the incremental difference between the existing building code in the state, and building practices. If building practices are behind code, there is some potential for savings; however, if building practices nearly meet or exceed code, this potential is small to none.

Rhode Island's process of reviewing and adopting model energy codes follows national development of these codes. Rhode Island tends to adopt new codes within a couple years of the IECC proposal. The state of Rhode Island adopted the 2012 IECC in July of 2013. Across the state, however, compliance with the 2012 IECC is estimated to be relatively low (approximately 40-50% in 2015). Additional support from utility programs (such as training of builders) is estimated to improve compliance from 2% in 2014 to 23-24% in 2017.

There is not much information regarding compliance in Hawaii. Hawaii Energy staff recently worked with local inspectors to build a database of over 1,000 new homes (covering a three-year period from 2011 to 2014) to better understand residential compliance with Hawaii's *existing* energy code (i.e., the 2006 code with amendments). These were primarily homes built by big builders, but they represent approximately 1/8th of all homes built during the three-year period.[8] According to Hawaii Energy's review of the 1,000+ homes in their database, most residential homes are built beyond the existing 2006-level code. No other information was available about compliance within the residential sector.

On the business side, Hawaii Energy conducted a brief review of commercial building plans in Maui and Hawaii in 2014-2015 to understand compliance with the existing 2006 equivalent code (Kolderup Consulting 2015). Based on this report, there were a few areas where the review of plans stated that compliance may be lower, although in many cases there was

[8] This is a rough estimate assuming 2,400 new single-family homes per year.

insufficient information to make a determination. Hawaii Energy staff and a local expert familiar with this topic concur that compliance with the *2006* code "looks pretty high."

These brief reviews suggest that building permits generally comply with IECC 2006 – but of course the existing codes are three cycles old. There is little or no information regarding what compliance rates might be if Hawaii enacts IECC 2015 or something higher. In all likelihood it will be quite important to support implementation and compliance.

A final lesson from Rhode Island is that, based on their experience, compliance-oriented activities are important, but they should be part of a broader set of activities that support codes and standards. Rhode Island has now expanded their efforts on a variety of fronts, including contributing to development of "reach" codes that go beyond the IECC levels.

Arizona: Developing a Master Fisherman.

Arizona has a long history of supporting codes and standards. One of the Arizona utilities, Arizona Public Service (APS), takes credit for a portion of savings from all new homes after a new code is adopted. In 2014, about 8% of their portfolio, or 37,177 MWh, came from savings from codes and standards. Of this, slightly over 5,000 MWhs were from new buildings and the remaining amount was from retrofits to meet code and appliance standards (APS 2015). APS invested between $75,000 and $150,000 in codes and standards support in 2014. Their efforts included: conducting code (residential, commercial and technical) training sessions throughout the year, supporting code jurisdiction processes when code update processes are ongoing, supporting builder and code official communities to build compliance paths to make achieving code compliance easier, supporting builder and code networks with sponsorships and support of initiatives, providing comment letters to intervene in US DOE Appliance Standard rulemaking processes, and aligning energy efficiency programs and incentives with code and standard market activity to encourage market transformation.

Structure for claiming savings. Program administrators in Arizona have negotiated an attribution number at the regulatory level based on advice and research from their evaluation consultant. Because of their history of support for moving the building industry forward, they are able to claim savings (1/3 of the total savings) for every building built after the adoption of the new rules. In addition, they have supported state specific appliance standards and been able to find savings from these measures.

The Arizona model is a model that may be relevant to Hawaii if they continue to invest in codes-related activities; however, Hawaii currently has no method for claiming program savings from codes and standards support. Thus, Hawaii Energy may find it difficult to support this area while still achieving their annual savings goals with existing budgets unless there is some mechanism for carving out program dollars and/or crediting code savings toward the goals.

Other unique characteristics of the state. Hawaii is different from Arizona in that the cooling load for Arizona is substantial, and thus offers significant opportunities for efficiency savings. Hawaii's mild weather, and the smaller-sized homes typical in island communities, means that the cooling load is low to begin with, so more stringent codes don't produce the same volume of savings. Average annual energy use in Hawaii is estimated to be about 7,600 kWh per year per household whereas the number is 10,104 kWh in Arizona. On the other hand, since energy use in Hawaii is relatively low to begin with, each unit of savings is important and valuable.

Table 2. Summary of state code related activities

	California (IOUs)	Arizona (APS)	Rhode Island (NGRID)
Existing Code	State Code: Title 24 (local can go beyond)	Local Codes: levels vary	State Code: 2012 IECC
Budget for Program Administrator Code Activities	Average was over $7.5 million per year for the four investor owned utilities combined[a]	$75,000 to $150,000	$200,000 per year
Savings from Codes and Standards as a 100% of full portfolio	23%[b] of portfolio over the 3-year period, but the large majority of this is from appliances (Title 20 and Federal Standards)	8% of portfolio, but the majority is from increased lighting standards, only about 1% from new construction (see below)	2-3% of portfolio
Code-related Electric Energy Savings from New Construction (and period) [gas not reported here]			
New Construction Savings Claimed for…	Advocacy Activities, Commercial Only	All New Buildings After Adoption of New Codes	Compliance Activities
Residential New Construction	None claimed	2,325 MWh (2014) — 0.5% of portfolio	550 MWh (2014) — 0.3% of portfolio
Business New Construction	Approx. 194 GWh/year for three utilities combined -- roughly 6% of portfolio[c]	2,988 MWh (2014) — 0.7% of portfolio	3,000 MWh (2014) —1.9% of portfolio
Code Activities (within claimed savings only, see description for all activities)	Primary activity is “advocacy” for new codes through Codes and Standards Enhancement (CASE) reports and Code Change Theory Reports (CCTR) for over 84 Title 20 (appliances), Title 24 (buildings), and federal codes.	Long history of programs and program-related trainings that move codes; work with some national agencies to support code enhancements	Focus groups, Classroom and field trainings, Energy code technical assistance, Circuit riders, and Code compliance documentation tools
Notes on savings estimates	Claimed 50% of savings in 2006-2008, but now claim 100% of net savings, with a proportional allocation between IOUs.	Negotiated estimate of 1/3 of annual savings in new buildings due to codes.	Claim savings from increase in compliance. Estimate that program will improve compliance from 2% in 2014 to 23-24% in 2017.[d]
Notes on applicability to Hawaii	Hawaii Energy could work to explore and push stretch codes beyond IECC. Hawaii does not currently affect codes (developed by ICC) to the extent that CA affects Title 24.	Hawaii Energy can provide a similar level of investment and support as Arizona. PBFA’s potential contribution to codes could be evaluated and incorporated into future budget cycles.	Hawaii does not have low compliance (although could provide similar support for compliance with new 2015-IECC codes, when adopted). Savings from compliance activities, however, are expected to be low compared to the potential from other future efforts.

Sources: (**CA)** Cadmus and DNV-GL 2014. **(AZ)** APS 2014. **(RI)** Discussion with NGRID staff and NMR et al.

a. In total, the annual average spending for all four code sub-programs was $9,711,627. (The four sub-program amounts include: Building Code Advocacy $4.643,051, Appliance Advocacy $3,006,890, Compliance Enhancement $1.274,765, Reach Codes $786,920.)
b. There are four sub-programs: Building Code Title 24 Advocacy and Appliance Standards Title 20 Advocacy (95% of savings); Compliance Enhancement (no savings); and Reach Codes (0.5% of savings). This table shows only the Advocacy sub-programs.
c. See Table 52 and 69 in the Cadmus report. This takes the estimate of 583 GWh and divides by three years. This does not include “layering in” of savings from earlier years. Most savings come from appliance standards.

Hawaii's Potential for Savings from Code Changes

Given all of the lessons from other states, how big are the potential savings from codes and standards in Hawaii? We offer a quick back-of-the-envelope estimate below.

Potential Residential Savings from Adoption of the 2015 International Energy Conservation Code

While there will be some savings from requiring all newly constructed homes to meet the 2015 code, based on our discussions with DBEDT, Hawaii Energy, and code experts in the state, the magnitude of these savings may be small both because of the small number of homes built each year, and the efficiency-levels of new homes. However, given that per household energy use in Hawaii is low to begin with, each additional unit of savings is valuable for meeting the state's aggressive energy reduction goals.

Based on the data available, the new homes are being built at an average of 32% "beyond existing [the 2006-level] code (Hawaii Energy 2015)." The savings for a home built under the 2015 IECC code would vary depending on whether it was a wood or steel frame, and the percentage of the space that was conditioned; but overall the savings for an optimized home would range from 13% to 48% savings over the 2006 code, where the high end represents savings for a fully optimized unconditioned home (Britt/Maleka Group 2015). The adoption of a new code (the IECC 2015 code) will lead to savings because some specific measures and practices will change, but the savings may not be large.

Per the DBEDT report, Measuring Housing Demand in Hawaii, 2015-2025 (DBEDT 2015), they estimate that ~2,400 single-family units are built each year, or 4,100 units including all residential building types. As mentioned above Hawaii's average energy use per home is estimated to be less than 8,000 kWh per year.[9] If new codes could increase energy savings another 10% beyond market practices currently in place, this represents approximately 2,800 MWhs per year using the following back-of-the-envelope calculation: (7,600 kWh/home * 10% *2,400 homes) + (6,000 kWh/MF unit * 10% *1,700 MF units) = 2,800 MWh/year over the life of the homes. Since buildings last roughly 70 years, the savings are appreciable over time.[10]

Overall, therefore, savings from the adoption of the 2015 IECC code are estimated to be closer to 10% as opposed the 35-40% savings between the 2006 and 2015 version because standard equipment levels and building practices are more efficient than existing codes.

Potential Business Savings from Adoption of the 2015 International Energy Conservation Code

While there is limited data on how current buildings practices in Hawaii compare to the 2015 IECC levels, insights from experts familiar with Hawaii commercial building practices (Kolderup Consulting 2015), by measure, include:

- **Lighting (and Retail Lighting):** Experts from Hawaii estimated that lighting power density for 2015 is a 30% improvement over 2006 and that most sectors are halfway there (10-15%), but retail is behind. As mentioned above, retail lighting is just complying or

[9] For the purposes of our calculation, we assume that new single-family homes use about 7,600 kWh/year according to Hawaii Energy's presentation at the December TAG meeting. We have also assumed that multi-family units use less: estimated at 6,000 kWh/year for our back of the envelope calculations.

[10] Here we borrow the 70-year building lifetime to remain consistent with a 2010 report commissioned by DBEDT in 2010 (Finch and Potes 2010).

not quite complying with the 2006 code. (The power densities in this sector are high simply due to how retail applies lighting, which makes it difficult to meet code.)

- **Daylighting Control Requirements**: According to experts on Hawaii codes, the 2015 code has new requirements for daylighting controls, and builders may need training on installation and commissioning.
- **Building Envelope/Window Area**: Within the 2015 code, window area is reduced (estimated to be from 40% to 30% of the total wall area), with some exceptions. For example, hotels and big buildings are likely to just build to the minimum code requirements, so incenting to get to the 2015 code could help move the industry faster. Concrete walls will also be required to have additional insulation under the 2015 code. This is more costly to the builders, and thus is unlikely to be implemented prior to code adoption. As such, incentives in this area could move the industry faster.
- **Commissioning**: The 2006 code required a "Commission Plan," but this is generally not included with filed plans that were examined in Hawaii Energy's sample. While it may be that commissioning is done and just not described in the plan, training in this area could help improve the efficiency of commercial buildings.

Given the measure-specific opportunities, there does appear to be potential for savings in the business sector from encouraging support for the 2015 IECC code. A recent report in Hawaii estimates that adopting the base of the 2015 code would save 35-40% energy over the 2006 code (Britt/Maleka Group 2015). Using rough estimates of lighting/electricity usage and HVAC usage per square foot in Hawaii from the National Energy Assessment 1992-2040, we estimate that (Livingston et al. 2014):

- HVAC site kWh/sq. ft. per year: Goes from 10.08 to approximately 7.1, a reduction of approximately 3 kWh/sq. ft. per year (30% reduction)[11]
- Lighting and electric site kWh/sq. ft. per year: Goes from 9.12 to approximately 7.1, a reduction of approximately 2 kWh/sq. ft. per year (22% reduction)
- Number of commercial sq. ft. built out each year: 2,180,487 sq. feet in Honolulu in 2015

Assuming that all new businesses are air-conditioned, back-of-the-envelope estimate could mean nearly 11,000 MWh/year savings in Honolulu county alone using the calculation: (total reduction of 5 kWh/sq. feet) * estimated 2,180,487 new commercial sq. feet[12] in 2015 = 10,900 MWh/year over the life of the building. Again, assuming a 70-year lifespan for buildings, the lifecycle savings are certainly worth capturing.

As such, there will be larger savings from adoption of the 2015 IECC and providing support for compliance. While overall it is expected that these savings will be less than the 35-40% difference between 2006 and 2015 levels, it is still expected to be a sizable percentage for many end-uses.

We also note that, if new codes are adopted in Hawaii, there are potentially even greater savings from commercial building retrofits that would also have to comply with new building codes, i.e., buildings undergoing major renovation are likely to trigger mandatory energy-efficiency provisions under the IECC and ASHRAE Standard 90.1.

[11] No source for 2015, but 2012 was estimated to be 7.91. Source: Livingston et al. 2014.

[12] This commercial square footage estimate is from an email exchange with DBEDT the week of December 15, 2015. Additional information provided in an appendix. Note that this is a "working estimate" and may be revised based on future discussions.

Conclusions and Recommendations for Hawaii

As shown by the case studies above, there are numerous ways that states can support codes and standards. The best approach will depend on the particular characteristics of the state. What works in California or Rhode Island, doesn't necessarily apply to Hawaii or other states. Hawaii, like other states that are considering finding additional savings through the support of new codes and standards, will need to be strategic in its application of the lessons from other states. Key considerations and learnings for states considering supporting code-related activities are captured in Table 3 below.

Table 3. Key considerations and learnings

Consideration	Description	Learning
Building codes versus appliance/equipment standards	Much of the savings from codes and standards actually come from the standards side.	This requires not only an investment in the processes to adopt new building codes, but a second investment in the process to change appliance and equipment standards
The importance of time	Savings from codes and standards implementation play out over time after the code/standard has been introduced	The initial investment may not be "cost effective" in the *initial* years of investment as measured in first year savings, but can be one of the most cost-effective investments in the portfolio based on long-term energy reductions.
Ability to affect state (and federal) codes	Some jurisdictions develop their own codes (like California) but many others rely on the IECC to develop codes. Moreover, the largest states are claiming program savings from their role in federal codes.	Many states, such as Hawaii, do not currently develop their own codes, but rather adopt codes already developed by the IECC. Hawaii could see even more energy savings by investing in statewide codes tailored to Hawaii.
Level of investment	States that show massive savings from codes and standards, also invest massive resources.	While there are significant savings available from moderate levels of investment, savings will vary depending on the resources available.
Number of new homes or buildings built	Savings from new building codes will depend on the number of new buildings built	Some savings (particularly those with limited land) and slower new building growth, which should be considered in estimating future potentials
Status of existing codes	Savings from new building codes will depend on existing codes (and practices)	The potential for savings from compliance activities are larger where current building practices are behind energy codes
Structure for claiming savings	The structure of counting savings can affect the overall magnitude of savings	It is important to understand how savings will be counted prior to investing (if these investments are required to be cost-effective).
Unique characteristics of the state	State characteristics such as weather or the starting energy use should also be considered	Mild weather, and low per home energy consumption will lead to lower savings from codes.

Even with all of the considerations above, there is the potential for savings in Hawaii from the support for new building codes. Based on a rough back-of-the-envelope estimate of potential savings in early 2016, the adoption of the 2015 IECC could lead to savings of 13,700 MWh per year for new buildings (or more depending on the number of new buildings built each year)—which is about 10% of the current savings claimed by Hawaii's PBFA each year. In

addition, if new codes are adopted, there are potentially even greater savings from commercial building retrofits that would have to comply with these codes. As such, stronger energy codes could help Hawaii reach their statewide energy reduction goals.

Based on their initial investigation, the Hawaii PUC will continue its review of the options for leveraging the Hawaii Energy programs to capture savings from codes and standards opportunities. Future activities under consideration include:

- **Build a stronger understanding of current building practices.** Since the majority of the savings are estimated to be in the business sector, the PUC is considering a more in-depth study for the business sector that could help them quantify future savings from code support. On the residential side, Hawaii Energy has a database that they can tap into and analyze (without additional data collection) to better understand what support may be needed for the residential sector.
- **Support counties and the state in their efforts to adopt more stringent codes.** Additional support by Hawaii Energy, such as checklists of what would need to be done to meet the 2015 IECC, technical assistance, and training tools can help market actors understand the baseline and how big the changes would be.
- **Explore opportunities to incent builders to voluntarily adopt more stringent building codes early.** Similar to in Arizona, aligning programs and incentives with planned and future codes can encourage market transformation. Hawaii is exploring whether there are ways to cost-effectively support proposed (and future) changes.
- **Conduct Hawaii-specific research and demonstrations, leading to technical papers or white papers, to move the state towards future building codes.** This is similar to California's case studies, but scaled to Hawaii's ability to invest. As budgets allow, Hawaii Energy may also look for ways to continue to move the state forward in their efforts to reach their net zero energy goals by conducting research on possible future code changes that would be specific to Hawaii.

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