



# ENERGY SAVINGS FORECAST FOR THE 2015 INTERNATIONAL ENERGY CONSERVATION CODE WITH HAWAII AMENDMENTS

Prepared for the  
**Department of Business, Economic Development, and Tourism**  
**State of Hawaii**



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## 1 INTRODUCTION

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The following report includes the construction and energy impact forecasts for residential and nonresidential projects in the years 2016, 2026, 2030 and 2036 based on the adoption of the 2015 International Energy Conservation Code (IECC) in the state of Hawaii with proposed amendments. Construction forecasts were completed using data from local building departments, Dodge data and construction starts collected previously by Kolderup Consulting.

The energy impact estimates compare the 2015 IECC to both the 2006 Hawaii Energy Code for residential buildings and to ASHRAE Standard 90.1-2004 for commercial buildings. The methodology used to determine the energy savings forecasts was based on the methodology and data used by Kolderup Consulting included in the report *Hawaii Building Energy Code Stringency Assessment and Savings Forecast*.<sup>1</sup>

## 2 RESIDENTIAL CONSTRUCTION FORECAST

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The forecast for residential construction is based on construction activity of the last 10 years (Table 1). Construction start data for 2005 to 2011 was based on Kolderup residential construction data derived from Dodge data. Estimated residential construction starts for 2012 to 2015 were based on building permit data from Oahu County. Permit activity was estimated for Hawaii, Kauai, Molokai and Lanai by extrapolating the Oahu permit data using population weighting for each island.

The data shows a ten-year average of 2,813 single-family homes per year and 1,420 apartment units per year (for multi-family buildings 3-stories and less). The data also shows a significant decline in construction since 2005 for both single-family and multi-family dwelling units which includes the years impacted by the recession.

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<sup>1</sup> Kolderup Consulting. "Hawaii Building Energy Code Stringency Assessment and Savings Forecast." (2012). 1 Nov. 2014. <[http://energy.hawaii.gov/wp-content/uploads/2011/10/Energy-Code-Stringency-Analysis\\_v5.pdf](http://energy.hawaii.gov/wp-content/uploads/2011/10/Energy-Code-Stringency-Analysis_v5.pdf)>.

Table 1 Residential Construction History – Number of Dwelling Units

Year	Single Family <sup>1, 2</sup>	Multi-family Units <sup>1,2,3</sup>
2005	6413	2490
2006	5191	1126
2007	4370	1342
2008	2653	987
2009	2145	381
2010	1702	1513
2011	1504	1100
2012 <sup>2</sup>	1377	1403
2013	1565	2147
2014	1209	986
2015	1307	3217
5-yr Average	1471	1771
10-yr Average	2813	1420

- <sup>1</sup> Dodge data provided by Mary Blewitt, Department of Business, Economic Development, and Tourism
- <sup>2</sup> Cumulative building permit data from 2012 to 2015 estimated based on Oahu Building Permit data
- <sup>3</sup> Multi-family data is for buildings 3-story and less in height

The residential construction forecast used in this analysis is illustrated in Figure 1 and Figure 2. The construction activity for 2016 is assumed to be equal to the 5-year average, which is 1,471 single-family units per year and 1,771 apartment units per year. For single-family dwelling units, the activity is assumed to increase until 2018 when it would reach the 10-year average. For multi-family units, the activity is assumed to decrease until 2018 when it would reach the 10-year average (Kolderup).

Figure 1 Residential Construction Forecast, Units per Year

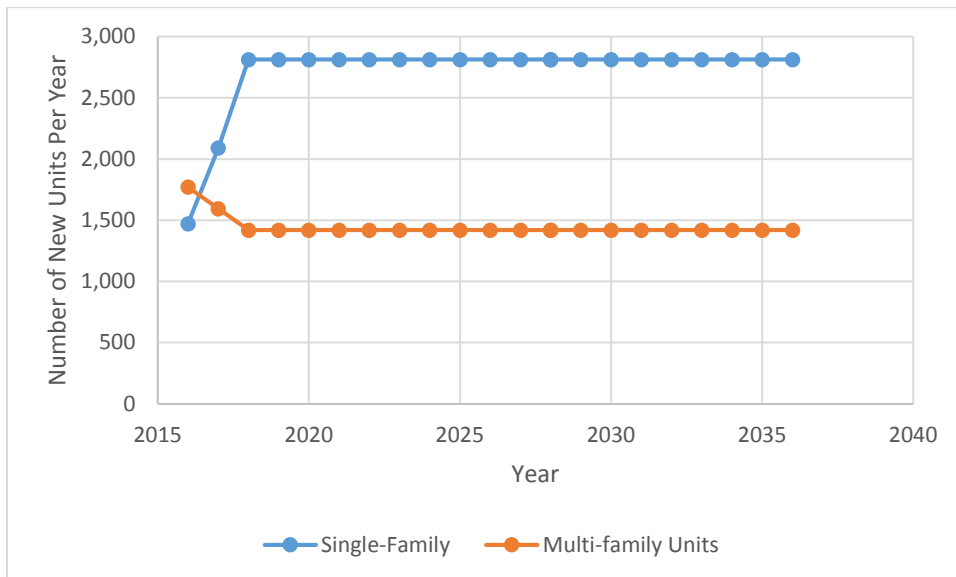
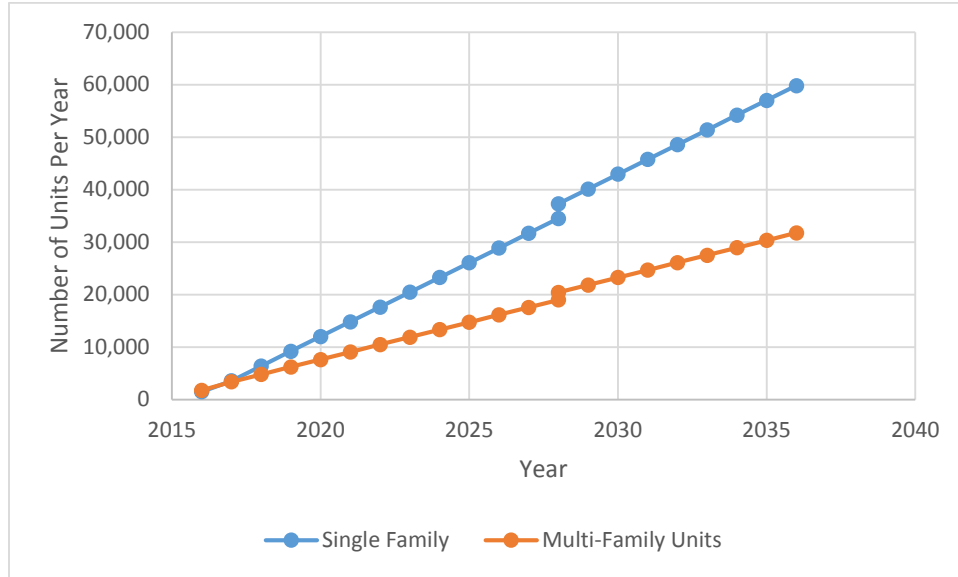


Figure 2 Residential Construction Forecast, Cumulative Number of Units



### 3 NONRESIDENTIAL CONSTRUCTION FORECAST

Nonresidential construction for 2016 is estimated to include 430,000 square feet per year of hotels and 1.49 million square feet per year of other nonresidential buildings (Kolderup). This rough estimate is based on Dodge data for permit value and the assumption that the average permit value is \$200 per square foot of floor area. Multi-family buildings 4-stories and greater are included in the nonresidential building category. The cumulative construction forecasts for 2016, 2026, 2030 and 2036 are summarized in Table 2.

Table 2 Nonresidential Construction Forecast, Square Feet of Floor Area<sup>1</sup>

Occupancy	Year			
	2016	2026	2030	2036
<b>Hotels</b>	430,000	4,300,000	6,020,000	8,600,000
<b>Other Nonresidential</b>	1,490,000	14,900,000	20,860,000	29,800,000
<b>Total</b>	1,920,000	19,200,000	26,880,000	38,400,000

<sup>1</sup> Dodge data provided by Mary Blewitt, Department of Business, Economic Development, and Tourism

### 4 RESIDENTIAL ENERGY IMPACT FORECAST

The estimated impact of the 2015 IECC with Hawaii amendments on residential energy is an energy savings of 2,048 MWh/yr in 2016 (year 1 representing the first year that the energy code would be adopted) compared to the 2006 IECC. The cumulative total increases to 368,723 MWh/yr in 2026 (year 10); 686,836 MWh/yr in 2030; and 1,316,924 MWh/yr in 2036 (year 20). The cumulative savings estimate

assumes that the energy saved by a building constructed in 2016 will save an equal quantity of energy for each year of the study (20 years). The cumulative energy savings for a 20 year analysis (ending in 2036) is the annual energy savings for houses built in 2016 multiplied by the number of years that the homes are in the analysis (20). The savings for a 2016 house is then added to the cumulative savings for houses constructed in 2017 which are only in the analysis for 19 years, and then to houses built in 2018 (18 years), etc. The process continues until all of the savings for houses built within the 20 period have been totaled. Calculations are summarized in Table 3. These estimates are based on the residential construction forecast described on pages 5 and 6 and the residential energy savings estimates detailed in Section 7 of the report *Analysis and Proposal of Hawaii Amendments to the 2015 International Energy Conservation Code*.<sup>2</sup> The forecast for energy impact was determined as follows:

The cumulative energy savings estimates were determined using EnergyPlus simulations for single-family dwelling units that were assumed to be fully air-conditioned and that complied with the requirements of the 2015 IECC with Hawaii amendments. Energy savings estimates for semi-conditioned buildings were determined assuming that the dwelling unit complied with the Tropical Zone requirements in the 2015 IECC with Hawaii amendments.

- The typical single-family home size is assumed to be 1,700 ft<sup>2</sup> rather than the 2,400 ft<sup>2</sup> house used in the analysis (Kolderup). The impact is assumed to reduce proportionately from 2,247 kWh/yr to 1,738 kWh/yr.
- As a rough estimate, 50% of all new homes statewide have air-conditioning and 50% of all new homes either have no air-conditioning or are semi-conditioned. This estimate is based on a Hawaiian Electric Companies (HECO) survey from 2014.
- The energy savings for apartment units is assumed to be 50% of the value calculated for single-family homes equal to 869 kWh/yr per apartment unit (Kolderup).

Table 3 Residential Energy Savings Forecast

Occupancy		Year			
		2016	2026	2030	2036
Single-Family	# Units	1,471	28,878	40,130	57,008
	kWh/yr-unit	1,738	1,738	1,738	1,738
	MWh/yr	1,279	283,178	532,830	1,053,977
Apartment <sup>1</sup>	# Units	1,771	16,146	21,826	30,346
	kWh/yr-unit	869	869	869	869
	MWh/yr	769	85,545	154,006	262,947
Total	# Units	3,242	45,024	61,956	87,354
	MWh/yr	2,048	368,723	686,836	1,316,924

<sup>1</sup> Apartments are 3-stories and less

<sup>2</sup> Britt/Makela Group, Inc. "Analyses and Proposal of Hawaii Amendments to the 2015 International Energy Conservation Code." (2014).



## 5 NONRESIDENTIAL ENERGY IMPACT FORECAST

The cumulative energy savings estimates were determined for 5 nonresidential occupancy types common to Hawaii construction using EnergyPlus simulations.

The estimated savings for nonresidential buildings under the 2015 IECC with Hawaii amendments is 10,914 MWh/yr compared to ASHRAE Standard 90.1-2004. The cumulative energy savings increases to 714,867 MWh/yr in 2016 (10 years); 1,304,223 MWh/yr in 2030; and 3,385,815 MWh/yr in 2036 (20 years). Cumulative savings were determined using the same methodology as was used for residential. The savings estimates are summarized in Table 4. This estimate combines construction forecast data described on page 7 with the energy savings estimate detailed in Section 7 of the report *Analysis and Proposal of Hawaii Amendments to the 2015 International Energy Conservation Code*.

Table 4 Nonresidential Energy Savings Forecast

Occupancy		Year			
		2016	2026	2030	2036
<b>Hotel</b>	ft <sup>2</sup>	430,000	4,300,000	6,020,000	8,600,000
	kWh/ft <sup>2</sup>	9	9	9	9
	MWh/yr	3,775	247,263	451,113	870,138
<b>Other<sup>1</sup></b>	ft <sup>2</sup>	1,490,000	14,900,000	20,860,000	29,800,000
	kWh/ft <sup>2</sup>	5	5	5	5
	MWh/yr	7,139	467,605	853,111	2,515,677
<b>Total</b>	ft <sup>2</sup>	1,920,000	19,200,000	26,880,000	38,400,000
	<b>MWh/yr</b>	<b>10,914</b>	<b>714,867</b>	<b>1,304,223</b>	<b>3,385,815</b>

<sup>1</sup> Other includes apartment buildings 4-stories and greater.

## 6 NET ENERGY IMPACT FORECAST

The net overall impact of the 2015 IECC with Hawaii amendments is estimated to be a savings of 12,962 MWh in 2016; 1,083,590 MWh in 2026 (year 10); 1,991,059 MWh in 2030; and 4,702,738 MWh in 2036 (year 20). These estimates are summarized in Table 5 which illustrates the expected energy savings in residential and commercial energy buildings assuming the 2015 IECC with Hawaii amendments is adopted in 2016.

Table 5 Combined Residential and Nonresidential Energy Forecast

Occupancy	Year			
	2016	2026	2030	2036
<b>Residential</b>	2,048	368,723	686,836	1,316,924
<b>Nonresidential</b>	10,914	714,867	1,304,223	3,385,815
<b>Total</b>	<b>12,962</b>	<b>1,083,590</b>	<b>1,991,059</b>	<b>4,702,738</b>

