

# REPORT



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## GENERAL GUIDELINES FOR PUBLIC AND COMMERCIAL BUILDING AUDIT AND RETROFIT STRATEGIES FOR ALASKA



Report to Alaska Housing Finance Corporation  
Related to Contract #02/10-01, Deliverable A.1  
Commercial-Sector Energy Efficiency Training Services

**NOTIFICATION**

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## GOAL

The goal of this work is to help Alaska Housing Finance Corporation (AHFC) develop general policy guidelines, for both building energy audits and subsequent retrofit activities, applicable to various public and commercial facilities across the diverse and often harsh climatic conditions occurring throughout the state of Alaska. It's important to note that detailed analyses of specific energy use and retrofit actions, for each building type, were beyond the scope of this contract.

## BACKGROUND

AHFC is working with several other public facility owners (Alaska Department of Education, Alaska Department of Transportation and Public Facilities, Alaska Municipal League) on a program to make energy efficiency retrofits to public buildings. AHFC is developing a loan program that will provide facility owners with funding for energy auditing and energy-related retrofits.

Cascadia Green Building Council (Cascadia) has been contracted by AHFC to assist in this work by developing 1) a list of building types most likely affected by the AHFC program and 2) general guidelines that can help outline best practices for building energy audits and subsequent retrofit activities for public buildings found in the many diverse communities across Alaska.

State, municipal and school district buildings come in a wide variety of building types, from small rural office buildings and schools to strip malls, large office buildings, convention centers and sports arenas. The guidelines developed here will help ensure best practices in both energy audit procedures and retrofit recommendations. For example, retrofit priorities may vary significantly for two identical buildings in different locations, depending on which building systems need most attention in its particular climate zone.

While these guidelines are intended for the AHFC loan program, they will be useful to private-sector lenders and building owners/managers as well. For that reason, some building types not normally associated with state and municipal facilities are included.

## ASSUMPTIONS

Since this work is of a general nature, we made the following assumptions:

1. We are looking at "normal use" of buildings. The scope of this work does not allow us to account for the variations in human use of any building, including occupant and operator behavior. Variability in human use is one factor that leads design engineers to oversize systems, which typically results in inefficient energy use. Addressing occupant and operator behavior is generally an educational effort separate from audit and retrofit considerations.
2. Audits and renovations of very large buildings, which typically have complex systems impacting energy use (e.g. simultaneous heating and cooling loads) will be handled by established energy service companies using performance contracts. The guidelines in this report are intended for smaller, less-complex buildings.
3. From an energy-use perspective, heating loads will dominate across Alaska, and the majority of buildings in this program will not have cooling loads.

In addition, we understand that for this program AHFC will require commercial building energy auditors be credentialed as Certified Energy Auditors through the Association of Energy Engineers<sup>1</sup>. All auditors will understand the audit procedures required with buildings of differing complexity.

## BUILDING TYPES AND SIZES

The primary factors important in the development of commercial-scale Audit and Retrofit guidelines are Building Type, Building Size and Climate Zone.

### BUILDING TYPES

We examined several established systems for classifying Building Type, typically developed to examine energy consumption. These include the Canada Commercial and Institutional Consumption of Energy Survey (CanCICES)<sup>2</sup>, the U.S. Department of Energy-Energy Information Administration Commercial Building Energy Consumption Survey (CBECS) and Residential Energy Consumption Survey (RECS)<sup>3</sup>, and the U.S. Environmental Protection Agency Energy Star program<sup>4</sup>.

For this AHFC program we recommend an Alaska-specific list, since none of these established lists adequately characterize, in total, the building types that may be part of the program. We drew primarily from the CanCICES, CBECS and RECS type lists. Recommended building types are defined in Appendix A. The building types in our list should also allow a building owner to utilize the EPA Energy Star program for benchmarking energy use.

Nationally, in the commercial sector, approximately 70% of buildings fall into three types – office, retail and warehouse<sup>5</sup>. As noted earlier, state and municipal offices are housed in a variety of building types.

### BUILDING SIZE

For many building types, total size is an important variable in this type of work; size is typically related to the complexity of the various energy-related systems. Further, the number of size categories will differ by building type and what loads are dominant. Even within a specific building type, how a building uses energy can change dramatically as the size of the building increases. Lacking existing information on the sizes of buildings that may be involved in the AHFC loan program, our recommended size classes (by building type) are based on experience gathered within the commercial building industry and what we expect to see in Alaskan markets.

Approximately 95% of public and commercial buildings in the United States are less than 50,000 square feet, and 90% are less than 25,000 square feet<sup>5</sup>. It's likely the proportions of small buildings are even higher in Alaska. We understand AHFC will collect data on building size as part of their program. If necessary, we can reassess our recommendations accordingly.

## CLIMATE ZONES

As part of their work to formulate appropriate energy codes for commercial buildings, AHFC has developed Alaska-specific amendments to the International Energy Conservation Code 2009 (IECC 2009). These amendments, adopted by reference in state statutes, are meant to be read in conjunction with the basic IECC 2009, and are commonly referred to as the “Commercial Building Energy Efficiency Standard” or “Commercial BEES.” Chapter 3 of Commercial BEES describes four climate zones for Alaska, based on Heating Degree Days (Appendix B). They are labeled Zone 6 – Southeast, Zone 7 – Southcentral, Zone 8 – Interior/Western and Zone 9 – Arctic Slope.

For the purposes of this type of audit/retrofit work we suggest three climate zones are sufficient – Southeast, Southcentral, and Interior/Western/Arctic. Dominant building loads and audit/retrofit strategies will likely be similar in the Interior/Western and Arctic zones, so we combined those into one category.

In terms of Heating Degree Days, our recommended zones break down as follows:

- Southeast – 7,200-9,000 HDD
- Southcentral – 9,000-12,600 HDD
- Interior/Western/Arctic – 12,600-21,000 HDD

It should also be noted that the Southeast climate zone varies dramatically from the Southcentral and Interior/Western/Arctic zones based on latitude (and therefore the amount of sunlight hours and solar radiant energy available) as well as appreciably milder winter ‘design’ temperatures and higher humidity conditions throughout the winter, all of which can affect building systems and loads.

## GENERAL GUIDELINES – BUILDING SYSTEMS AND AUDIT / RETROFIT STRATEGIES

While the quality of public and commercial building construction depends on numerous things (e.g. year built, existing codes, etc.) and varies greatly across Alaska, it is generally true that most buildings were designed for cheap fossil fuel. In most cases building envelope costs – related to insulation, windows and infiltration – were minimized to lower first costs in favor of oversized (and often inefficient) heating and ventilation systems. Unpredictability in occupancy behavior and building operator behavior also lead design professionals to oversize systems.

Infiltration and other envelope issues are important in all climate zones, and increasingly important as Heating Degree Days increases. Infiltration should be minimized (with proper ventilation) in all zones. In retrofit situations it is typically easier to address infiltration than insulation levels.

At the same time, as buildings get ‘tighter,’ it is critical to pay attention to proper ventilation to maintain safe indoor air quality, especially if there are internal combustion sources like woodstoves. If a building is vented internally, and combustion occurs within the building, there is also a need to pay attention to moisture issues.

The building systems that impact energy use energy in public/commercial buildings are:

- Envelope – including Infiltration, Insulation and Windows
- Heating (and controls)
- Ventilation (and controls)
- Cooling/Air Conditioning (and controls)
- Lighting and Lighting Controls

- Domestic Hot Water
- Plug Loads (TV's, computers, refrigerators etc.)
- Process Loads (factory loads)
- Pumps and Motors (often part of other systems)
- Special Equipment (e.g., refrigerators/freezers in grocery stores, elevators and conveyance systems)

Table 1 outlines important building systems contributing to energy use, and general audit/retrofit considerations, by Building Type, Size and Climate Zone. We assume energy audit *procedures* will be relatively standard, but Table 1 should be consulted to ensure that zone-appropriate actions are emphasized for buildings of differing complexity. The “low hanging fruit” for energy retrofits will differ depending on climate zone, local fuel costs, available financial resources, etc.

Space heating will likely be the dominant load across Alaska, and because heating and ventilation (and air conditioning, when it occurs) systems are typically handled together we lumped them all into Heating/Ventilation/Air Conditioning (HVAC).

Controls and system integration can be a key area of focus for audits of larger buildings, since ventilation rates are often high and poor system control and operation has a huge impact on energy use<sup>5</sup>. While building envelope factors like infiltration and insulation are important across building types and climate zones, in a relative sense the envelope becomes less important as building size and complexity increases (although it remains important in Alaska for all building sizes). Small buildings can be said to be ‘envelope driven’ meaning that the majority of its loads are due to losses through the envelope. A large building is ‘internally load dominated’ where things like lighting, elevators and plug loads dominate.

As a very simple example, on a large building a poorly insulated envelope will drive up the heating load, but it may drive it up unequally. To respond to perimeter comfort issues, the HVAC system will be cranked up, but then the interior offices will become uncomfortably warm, and you will either have simultaneous heating and cooling, or efforts to circumvent control systems, or some combination of these and other responses. So then the energy use impact may also include cooling and fan energy and becomes magnified beyond the simple heating load generated by lack of adequate insulation. When humidity control, distribution issues, lack of system maintenance, and other issues are considered, it's clear there is much more to focus on than just the ‘environmental loads’.

Because pumps and motors are typically components of other systems we generally did not address them separately. It should be noted, however, that while pumps and motors are often a relatively small part of the overall energy use, upgrades to these items often have a very fast payback<sup>5</sup>.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has developed advanced design guides for some building types and sizes (for example, they define “Small Office” as up to 20,000 square feet, and “Small Warehouse” as up to 50,000 square feet)<sup>6</sup>. These would apply to the majority of public/commercial buildings in Alaska, though more investigation may be necessary to determine whether their recommendations adequately account for Alaska's climatic conditions.

Finally, we recommend AHFC encourage life cycle costing (LCC) be employed when making determinations of retrofit strategies and return on investment. Factors such as equipment efficiency and local fuel costs (including future fuel cost projections) will have a large impact on LCC analyses. As an example, the General Services Administration includes the following language in its Facilities Standards for Public Buildings Service<sup>7</sup>:

*LCC is expected to support selection of all building systems that impact energy use: thermal envelope, passive solar features, fenestration, HVAC, domestic hot water, building automation and lighting.*

## END NOTES

1. Association of Energy Engineers. <http://www.aeecenter.org>.
2. Commercial and Institutional Consumption of Energy Survey (Canada) – Summary Report June 2007. Natural Resources Canada, Office of Energy Efficiency, Energy Publications. Cat. No. M141-17/2005E-PDF, ISBN 978-0-662-45479-3. <http://oee.nrcan.gc.ca/Publications/statistics/cices06/index.cfm>.
3. U.S. Department of Energy-Energy Information Administration, Commercial Building Energy Consumption Survey, <http://www.eia.doe.gov/emeu/cbecs/>, and Residential Energy Consumption Survey, <http://www.eia.doe.gov/emeu/recs/contents.html>.
4. U.S. Environmental Protection Agency Energy Star program. [http://www.energystar.gov/index.cfm?c=eligibility.bus\\_portfoliomanager\\_space\\_types#bank](http://www.energystar.gov/index.cfm?c=eligibility.bus_portfoliomanager_space_types#bank).
5. Mark Frankel, New Buildings Institute, personal communication, October 14, 2010.
6. Advanced Energy Design Guides, American Society of Heating, Refrigerating and Air-Conditioning Engineers, <http://www.ashrae.org/technology/page/938>.
7. U. S. General Services Administration Facilities Standards for Public Buildings Service, Chapter 1, Section 1.8 (2005 version P100). [www.gsa.gov/p100](http://www.gsa.gov/p100).

## TABLES

Table 1. Building systems important in audit and retrofit work, by building type and climate zone, for public/commercial buildings in Alaska.

## APPENDICES

- A. Building Type definitions and examples.
- B. Climate Zones used by Alaska Housing Finance Corp.

**TABLE 1. BUILDING SYSTEMS IMPORTANT IN AUDIT AND RETROFIT WORK, BY BUILDING TYPE AND CLIMATE ZONE, FOR PUBLIC/COMMERCIAL BUILDINGS IN ALASKA.**

Building Type and Size See Appendix A for Type definitions	Zone 6 - Southeast 7,200-9,000 HDD	Zone 7 - Southcentral 9,000-12,600 HDD	Zones 8&9- Interior/Western/Arctic 12,600-21,000 HDD	General Comments
<b>SYSTEM LEGEND:</b> <b>E</b> = Equipment; <b>ENV</b> = Envelope (windows/walls/roof); <b>DHW</b> = Domestic Hot Water; <b>C</b> = Cooling and Controls; <b>INF</b> = Infiltration; <b>LLC</b> = Lighting and Lighting Controls; <b>P</b> = Plug Loads; <b>V</b> = Ventilation and Controls				
<b>Buildings of Primary Interest to AHFC</b>				
<b>Education - K-12</b>				
Single classroom/portable	ENV, INF	ENV, INF	ENV, INF	K-12 facilities can vary dramatically in how they use energy, although they all tend to be heating load dominated in Alaskan climates. Size plays a big factor but so do specialty programmatic services such as cafeterias, gymnasiums and showers, labs (chemistry and computer) and shops. Night setbacks, if properly done, can be useful, but can also be counterproductive if morning warm-up is not well managed. Daylight controls can reduce lighting loads in more southerly Alaskan locations. High performance windows are especially important in cold areas. Hot water loads present a big opportunity in larger schools.
Schools less than 30,000 SF	ENV, INF, DHW	ENV, INF, DHW	ENV, INF, DHW	
Schools greater than 30,000 SF	ENV, INF, DHW	ENV, INF, DHW	ENV, INF, DHW	
<b>Health Care – Nursing/Residential Care</b>				
	ENV, INF, DHW, LLC	ENV, INF, DHW, LLC	ENV, INF, DHW, LLC	This building type tends to behave very similar to multi-family, however set point temperatures are often much tighter and much higher in the winter resulting in even greater heating loads than multi-family. Loads can vary depending if the facility has separate kitchens for all occupants or whether there is communal eating. Lighting and hot water can have significant loads whereas plug loads tend to be lower than in typical multi-family structures. It should be determined if the facility has operable windows which can greatly affect infiltration.
<b>Mall</b>				
Strip Mall	INF, LLC, ENV	INF, ENV, LLC	INF, ENV, LLC	This building typology tends to come in two major forms: strip malls and enclosed malls. Strip malls tend to be smaller in size and customers enter directly into the stores from the outside. There is greater perimeter area and therefore the envelope tends to play a larger role. Enclosed malls are typically larger and have a few entrances that then serve many individual stores inside, with internal circulation. While these two building types are similar in a programmatic sense they often use energy very differently. The strip mall suffers from having a greater number of entrances relative to the internal square footage and higher envelope losses through more windows and through doors constantly being opened. These stores are well served through good vestibule design, good lighting design and then aggressive set backs. The windows in shopfronts can also be a source of significant heat loss. The enclosed mall typically has few windows and better vestibule design that reduces airflow at the entranceways. Having a solid envelope – good R values – can be key, as well as not overlighting the interior.
Enclosed Mall	LLC, C, V	ENV, LLC, C, V	ENV, LLC, V	

**TABLE 1. BUILDING SYSTEMS IMPORTANT IN AUDIT AND RETROFIT WORK, BY BUILDING TYPE AND CLIMATE ZONE, FOR PUBLIC/COMMERCIAL BUILDINGS IN ALASKA** (continued).

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<b>SYSTEM LEGEND:</b> <b>E</b> = Envelope (windows/walls/roof); <b>DHW</b> = Domestic Hot Water; <b>C</b> = Cooling and Controls; <b>INF</b> = Infiltration; <b>LLC</b> = Lighting and Lighting Controls; <b>P</b> = Plug Loads; <b>V</b> = Ventilation and Controls				
<b>Office</b>				As office buildings get larger they become more internally load driven. Computers and other plug loads, as well as lighting, can dominate. Typically office buildings have a large degree of glass on their facades, which can create cooling loads even in cool temperatures. Specific building design can make a big difference. As buildings become bigger envelope issues diminish with the exception of potential cooling loads from solar gain. If there is a cooling load, it's always from internal gains and (some) solar gain, and economizers should be high on an audit list. However, economizers often do not work correctly. Glazing area is often a good predictor of heating and cooling loads.
Less than 20,000 SF	LLC, P, ENV	ENV, LLC, P	ENV, LLC, P	This building typology is a wide category that applies to any building that serves as a place of congregation for large numbers of people. As a result ventilation loads can be considerable and there can sometimes be a need for air conditioning as well as heating. Examples include churches, museums, auditoriums and theaters. Specialty equipment can sometimes drive significant energy use such as high lighting loads in the case of theaters. Almost all these facilities share the trait of having very sporadic use and significant energy savings can be realized through having good control systems that put the building in 'unoccupied modes'. Motion sensors can be tied to lighting use and CO2 sensors can help control ventilation, for example. As with all building types the larger the public assembly building the less significant the role that the envelope plays in energy use compared with internal loads. That said, the greater the degree days the larger role the envelope plays. No natural size break in how these buildings are configured. There are commonalities with many school space functions.
20,000-50,000 SF	LLC, P, ENV	ENV, LLC, P	ENV, LLC, P	
Greater than 50,000 SF	LLC, P, V, C	LLC, P, V, C	LLC, P, V	
<b>Public Assembly</b>	V, ENV, LLC	V, ENV, LLC	ENV, V, LLC	
<b>Public Order and Safety</b>				There is no natural size break in these facilities. Police facilities tend to have higher plug loads than fire stations and tend to behave similar to office buildings. Fire stations often have a residential component with greater hot water use. Prisons, which house many people, tend to have higher ventilation loads, hot water and cafeteria loads. Lighting can also be significant in prisons.
Police Stations	ENV, P, LLC	ENV, P, LLC	ENV, P, LLC	
Fire Stations	ENV, DHW	ENV, DHW	ENV, DHW	
Prisons	V, LLC, DHW, ENV	V, LLC, DHW, ENV	V, LLC, DHW, ENV	

**TABLE 1. BUILDING SYSTEMS IMPORTANT IN AUDIT AND RETROFIT WORK, BY BUILDING TYPE AND CLIMATE ZONE, FOR PUBLIC/COMMERCIAL BUILDINGS IN ALASKA** (continued).

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<b>Residential Multi-Family</b>				
2-4 Units	ENV, INF, P, LLC	ENV, INF, P, LLC	ENV, INF, P, LLC	Externally load dominated building type, largely heating driven in Alaska with a high degree of perimeter area in relation to internal loads. Good insulation, tight construction minimizing infiltration and good windows are a necessity. Efficient lighting and energy star appliances for refrigerators, washers and dryers can mean a lot.
5+ Units	ENV, DHW, P, C	ENV, DHW, P	ENV, DHW, P	Multi-family housing tends to behave very similar to single-family but as the number of units increases the losses due to envelope and infiltration become relatively less important, and internal loads like appliances and hot water become more important. Cooling may be possible in southeast Alaska. Typically there are no lighting controls present in this building type except possibly in building common areas like laundry rooms.
<b>Warehousing and Wholesale</b>	Too much variability within type to suggest differences between climate zones.			With warehousing it's important to determine the type and use. Warehouses are often not heated. If it's not heated then loads are lighting and minimal plug loads. If they are heated then envelope and infiltration tends to dominate. Some warehouses control for humidity and others are cooled depending on the type of goods stored.
<b>Buildings of Secondary Interest to AHFC</b>				
<b>Accommodation Services</b>				
External door motel-type	ENV, INF, DHW, LLC	ENV, INF, DHW, LLC	ENV, INF, DHW, LLC	All climate zones: pay attention to user controls, auto shut-offs/door closers, and perimeter envelope.  This building typology typically has individual rooms with external doors and individual room controls. The buildings are typically one- or two-story and are externally load dominated. Infiltration and envelope losses can be significant. How water needs can also be significant due to laundry facilities and shower loads. Motels are often seasonal and may not be active in the coldest months. Some motels may include air conditioning.
Internal door hotel-type	ENV, INF, DHW, V, E	ENV, INF, DHW, V, E	ENV, INF, DHW, V, E	Motels operate somewhat similar to hotels yet typically have a main entrance with internal doors that open into an atrium or off internal corridors. Envelope losses are greatly minimized as a result. Typically there are other internal loads such as elevators that get high use as well as hot water loads in laundry facilities and shower loads. Lighting controls can be used successfully. Hotels are less likely to be seasonal in nature and have to keep people comfortable in hot as well as cold weather. Air conditioning may be common. If hotel has a pool, restaurant or other special facilities they can present new challenges and opportunities for energy reductions.

**TABLE 1. BUILDING SYSTEMS IMPORTANT IN AUDIT AND RETROFIT WORK, BY BUILDING TYPE AND CLIMATE ZONE, FOR PUBLIC/COMMERCIAL BUILDINGS IN ALASKA** (continued).

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<b>Food Service and Drinking Places</b>	P, DHW, ENV, LLC	P, DHW, ENV, LLC	P, HW, ENV, LLC	Food establishments tend to be driven by internal loads such as cooking and baking, dishwashers and other equipment, but also lighting and people (ventilation) loads. Hot water demands can be great. Heating is always an issue in Alaska climates. Restaurant use can be intermittent – so setback conditions can become a meaningful strategy.
<b>Health Care - Hospitals</b> Greater than 50,000 SF	P, LLC, V	P, LLC, V	P, LLC, V	Hospitals are among the most energy intensive building types in existence. They typically use significant amounts of energy-intensive equipment that are rarely shut off and operate 24 hours a day/365 days a year. Lighting levels tend to be significantly higher than in other building types. In addition interior conditions are strictly regulated – tight set point temperatures and tight control over humidity and ventilation is often required.
<b>Residential</b> Both single-family attached and single-family detached	ENV, INF, P, LLC	ENV, INF, P, LLC	ENV, INF, P, LLC	The typical home or duplex is the classic externally load dominated building. It is largely heating driven in Alaska with a high degree of perimeter area in relation to internal loads. Good insulation, tight construction minimizing infiltration and good windows are a necessity. Efficient lighting and energy star appliances for refrigerators, washers and dryers can mean a lot. Envelope and infiltration become increasingly predominant as HDD increases.
<b>Retail - food</b>	E, LLC, INF, ENV	E, LLC, INF, ENV	E, LLC, INF, ENV	Supermarkets have huge equipment loads, especially related to refrigeration. Differentiation is related more to scale of refrigeration than building size. Lighting typically presents opportunities for energy-use reductions, as lighting is typically too bright (in footcandles) and often there is lighting within the cases as well as specialty (incandescent) lighting.
<b>Retail - non-food</b>	LLC, V	LLC, V	LLC, V	Retail establishments can vary dramatically in how they use energy. As with any building type, size matters – and with retail volume also matters. Some shops are quite small and have very few internal loads beyond lighting. Others like giant big-box retail can have very high ceilings and refrigeration. If the retail has refrigeration it can be a sizeable portion of the energy use of the building.
<b>Other</b>	Variable depending on building use			Most other buildings will be special-use buildings and require special analyses. E.g. Industrial buildings will have high process loads, museums are similar to Public Assembly buildings but with more strict humidity and temperature requirements, water/wastewater treatment and distribution facilities will have high loads due to pumps and motors, etc.

**APPENDIX A. BUILDING TYPE DEFINITIONS AND EXAMPLES.**

<b>Building Type and Size</b>	<b>Examples</b>	<b>Source [see footnote 1]</b>
<b>Buildings of Primary Interest to AHFC</b>		
<b>Education - K-12</b>	Academic/technical classroom instruction, such as elementary, middle and high schools, and classroom buildings on college/university campuses. Buildings on education campuses for which the main use is not classroom are included in the category related to their use.	CBECs
Single classroom/ portable		
School less than 30,000 SF		
School greater than 30,000 SF		
	<i>NOTE: For schools, special services (such as cafeteria, stage, shop, lab) are often the defining characteristic of school building loads. Otherwise, size may just be a function of how many classroom are included.</i>	
<b>Health Care - Nursing/ Residential Care</b>	Nursing care facilities; Residential Developmental Handicap, mental health and substance abuse facilities; Community Care facilities of the elderly; other residential care facilities	CanCICES
<b>Mall</b>	Shopping malls composed of multiple connected establishments.	CBECs
Strip Mall		
Enclosed Mall		
<b>Office</b>	Buildings used for general office space, professional office, or administrative offices. Medical offices are included here.	CBECs
Less than 20,000 SF		
20,000-50,000 SF		
Greater than 50,000 SF		
<b>Public Assembly</b>	Buildings in which people gather for social or recreational activities, whether in private or non-private meeting halls	CBECs
	<i>NOTE: No natural size break in how these building configured, and use is highly variable. There are commonalities with many school space functions.</i>	
<b>Public Order and Safety</b>	Buildings used for the preservation of law and order or public safety. Includes police/fire stations, jails/penitentiary, courthouse or probation office.	CBECs, modified
	<i>NOTE: Prisons are complex systems with little relation, in energy use, to any other building type.</i>	

**APPENDIX A. BUILDING TYPE DEFINITIONS AND EXAMPLES** (continued).

Building Type and Size	Examples	Source (see footnote 1)
<b>Residential - Multi-Family</b>		RECS
2-4 Units	A structure that is divided into living quarters for 2, 3 or 4 families or households in which one household lives above or beside the another. This category also includes houses originally intended for occupancy by 1 family (or for some other use) that have since been converted to separate dwellings for 2-4 families. Typical arrangements in these types of living quarters are separate apartments downstairs and upstairs or one apartment on each of 3 or 4 floors.	
5+ Units (see note as well.)	A unit in a building with 5 or more housing units - a structure that contains living quarters for 5 or more households or families and in which one household lives above or beside another.	
	<i>NOTE: high-rise condos/apartments often differ from other apartment/condo complexes in common area systems and features. If AHFC anticipates much work on high-rise condos more information is available.</i>	
<b>Warehousing and Wholesale</b>	Wholesale-Distributors for: farm products, petroleum products, foods and beverages, personal and household goods, motor vehicle parts, building materials, etc. Buildings used to store goods, manufactured products, merchandise, raw materials or personal belongings (such as self-storage).	CanCICES
<b>Buildings of Secondary Interest to AHFC</b>		
<b>Accommodation Services</b>	Dormitories, Senior Living, Traveler accommodations (not including Nursing/Residential Care)	CanCICES
External door Motel-type, less than 4 stories		
Internal Door Hotel-type		
Up to 4 stories		
Greater than 4 stories		
<b>Food Service and Drinking Places</b>	Full service restaurants; limited-service eating places; special food services, drinking places (alcohol)	CanCICES
<b>Health Care - Hospitals</b>	General medical and surgical hospitals; psychiatric and substance abuse hospitals; specialty hospitals.	CanCICES
Less than 50,000 SF		
Greater than 50,000 SF		

**APPENDIX A. BUILDING TYPE DEFINITIONS AND EXAMPLES** (continued).

<b>Building Type and Size</b>	<b>Examples</b>	<b>Source (see footnote 1)</b>
<b>Residential</b>		RECS
Single-Family Detached	A single-family house is contained within walls extending from the basement (or the ground floor, if no basement) to the roof.	
Single-Family Attached	Attached houses are considered single-family houses as long as they are not divided into more than one housing unit and they have independent outside entrances.	
<b>Retail - food</b>	Grocery stores; specialty food stores; beer/wine/liquor stores	CanCICES
	<i>NOTE: Differentiation is related more to scale of refrigeration than building size</i>	
<b>Retail - non-food</b>	Non-food retail (not in a mall); gasoline stations.	CanCICES
<b>Other</b>	Buildings that are industrial or agricultural with some retail space; buildings that have several different commercial activities that, together, comprise 50% or more of the floorspace, but whose largest single activity is agricultural, industrial/manufacturing, or residential; and all other miscellaneous buildings that do not fit into any other category. Also special-purpose buildings like water/wastewater treatment and distribution, museums, data centers.	CBECS

## 1. Sources:

CanCICES - Canada Commercial and Institutional Consumption of Energy Survey

CBECS - U.S. Department of Energy-Energy Information Administration Commercial Building Energy Consumption Survey

RBECS - U.S. Department of Energy-Energy Information Administration Residential Energy Consumption Survey

## APPENDIX B. CLIMATE ZONES USED BY AHFC, AND ALASKA-SPECIFIC AMENDMENTS TO THE IECC 2009 (COMMERCIAL).

June 14, 2010

This document is a list of Alaska-specific amendments to the International Energy Code 2009, First Printing, January 2009 (IECC 2009) adopted by reference in 15 AAC 155.XXX on August 18, 2010. It is meant to be read in conjunction with the IECC 2009 which may be purchased at local bookstores. These amendments are focused only on the use of the IECC 2009 as the Commercial Building Energy Efficiency Standard for Alaska as adopted in 15 AAC 155.XXX; they are not meant to be used for residential construction projects and do not supplant the BEES amendments to IECC 2006 for residential projects as adopted on June 17, 2009. The IECC 2009 as amended herein shall be known as the “Commercial BEES.” These amendments are numbered and organized by the chapter and section numbers found in the IECC 2009 and follow immediately:

### CHAPTER 3 - Climate Zones

**301.1 General.** IECC 2009 Figure 301.1 and Table 301.1 shall be replaced with Figure A301.1 and Table A301.1(1), respectively, below. Table A301.1(2) is provided for comparison with the Climate Regions from previous versions of the Alaska Building Energy Efficiency Standard (“old BEES”).

Table A301.1(1) Climate Zones for Alaska by Census Area			
Zone 6	Zone 7	Zone 8	Zone 9
Juneau	Aleutians East	Bethel	North Slope
Ketchikan Gateway	Aleutians West	Denali	
Prince of Wales	Anchorage	Fairbanks North Star	
Sitka	Bristol Bay	Nome	
Skagway- Hoonah Angoon	Dillingham	Northwest Arctic	
Wrangell-Petersburg	Haines	Southeast Fairbanks	
Yakutat	Kenai Peninsula	Wade Hampton	
	Kodiak Island	Yukon-Koyukuk	
	Lake and Peninsula		
	Matanuska-Susitna		
	Valdez-Cordova		

301.1(2) - Climate Zones for Alaska by HDD*			
IECC zones for Alaska	HDDa Range (IECC)	Old BEES Climate Regions	HDDa Range (BEES)
Zone 6	7200 - 9000	Region 1 - Southeast	7000-10,700
Zone 7	9000 -12,600	Region 2 - Southcentral	8600-13,500
Zone 8	12,600 -16,800	Region 3 & 4 - Interior & Western	11,300-17,700
Zone 9	16,800 -21,000	Region 5 - Arctic Slope	16,900-20,300

\* HDD = Heating Degree Day (based on 65 degrees Fahrenheit)