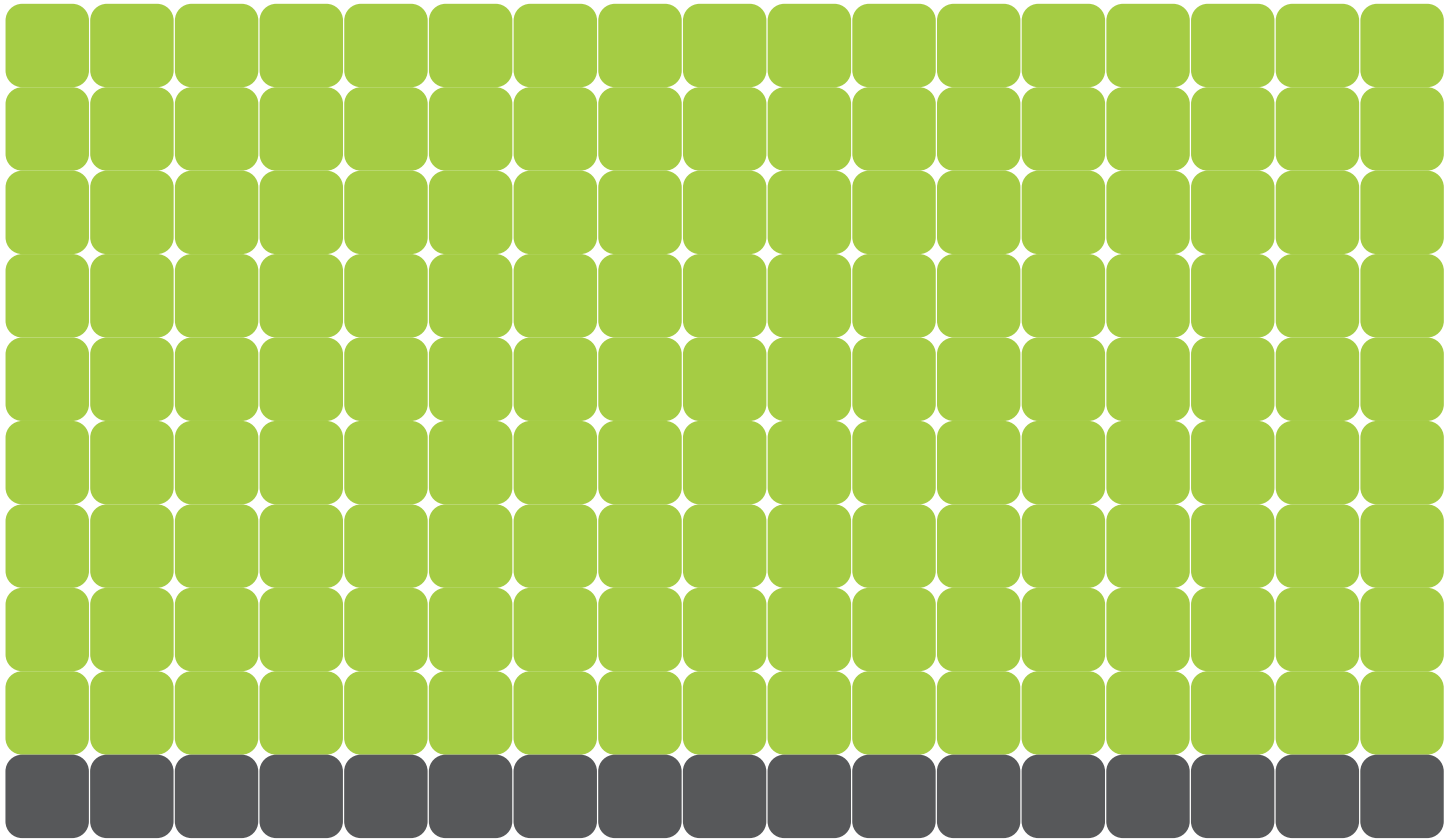
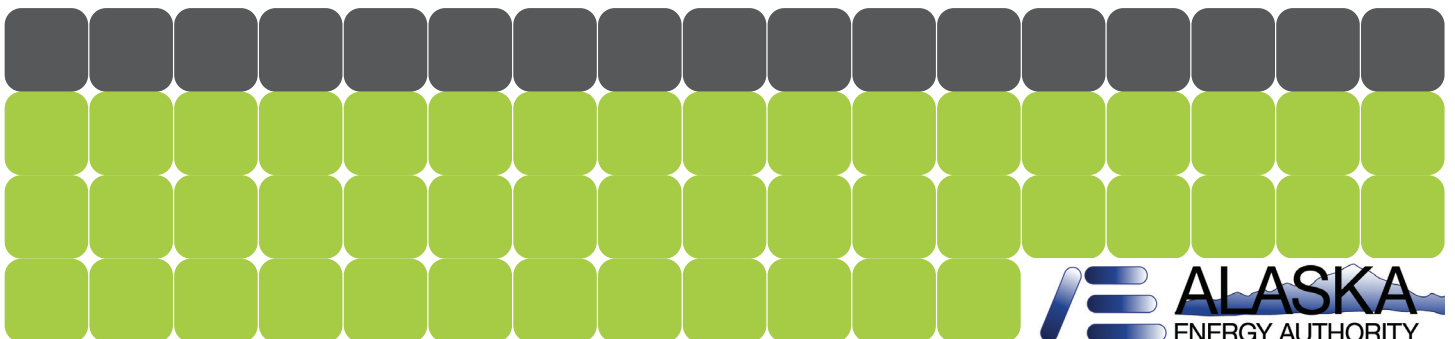




ALASKA ENERGY

END USE STUDY : 2012



OVERVIEW

2012

The purpose the End-use Study (EUS) is to provide energy end-use data for residential and non-residential buildings in Southeast Alaska (Climate Zone 6), Southcentral Alaska (Climate Zone 7), Fairbanks/Interior (Climate Zone 8), and the rural North/Northwest Alaska. The study also provided basic end-use energy and building benchmark information on other categories, including street lighting and water/wastewater treatment infrastructure.

The state of Alaska has established a goal of 15% reduction in end-use energy use by 2020. For the purposes of this study, this can be defined as:

“Alaska shall achieve a 15 percent reduction in the amount of heating fuel and electricity used on a per capita basis in the residential and commercial building sectors, as well as public facilities such as street lighting and water/sewer facilities, between the base year of 2010 and the year 2020.”

RAILBELT AND SOUTHEAST RESIDENTIAL ENERGY USE

Residential energy use represents a prominent policy and programmatic target for policy makers. Major conclusions of residential energy use include the following:

- The average residence in the Railbelt and Southeast Alaska (SEAK) regions uses 269 MMBTUs in energy each year, and total energy use of 59 million MMBTUs.
- Residents of Railbelt and SEAK use about 80% of their total energy (in MMBTUs) to heat their homes.
- Single family detached residences use more energy than other types of residences. Multifamily residences use the least.
- Natural gas is the primary fuel for home heating in 64% of households in Railbelt and SEAK, and oil is the primary fuel in Southeast Alaska.
- Domestic hot water uses between 9% and 11% of total energy in Railbelt and SEAK homes.
- Electrical appliances use between 8% and 10% of all MMBTUs among respondent households in Railbelt and SEAK, but consume 65% of all electrical energy.
- The operation of major appliances such as refrigerators, freezers, washers and dryers is the largest single residential use of electrical energy in all the Climate Zones within Railbelt and Southeast Alaska (24% of electrical energy).
- Mobile homes have the highest energy intensity (KBTU/ft²) in space heating, domestic hot water production and operating appliances.

FIGURE 1

Total energy use/yr per home by climate zone for Railbelt & SEAK (pop weighted, MMBTU)



Figure 1 shows the total energy used by residences in each of the climate zones for the Railbelt and SEAK. On average, homes in the more temperate Climate Zone 6 use less energy than those in the colder climate zones. The use of energy in Southcentral Alaska (Railbelt, Climate Zone 7) is slightly higher than energy use in Climate Zone 8. On average homes were 6% larger in Climate Zone 7 than in Climate Zone 8.

FIGURE 2

Railbelt & SEAK Total Energy Use by Fuel Type and Climate Zone

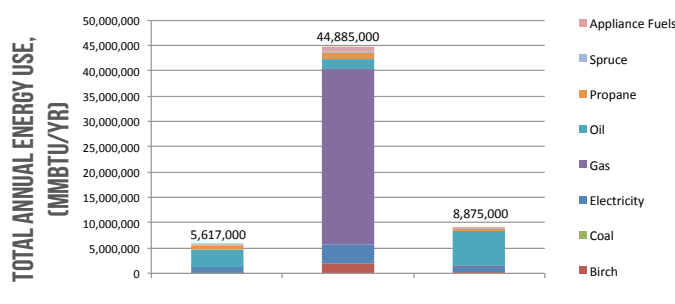


Figure 2 compares state-wide total energy use by all fuel types for each climate zone within the Railbelt and SEAK study areas. Climate Zone 7 has by far the largest total energy use due to a substantially larger population than other climate zones. Total Railbelt and SEAK residential energy use within this study is 59.38 million MMBTUs.

FIGURE 3

Total energy by major energy use per home by Climate Zone (pop wt, MMBTU)

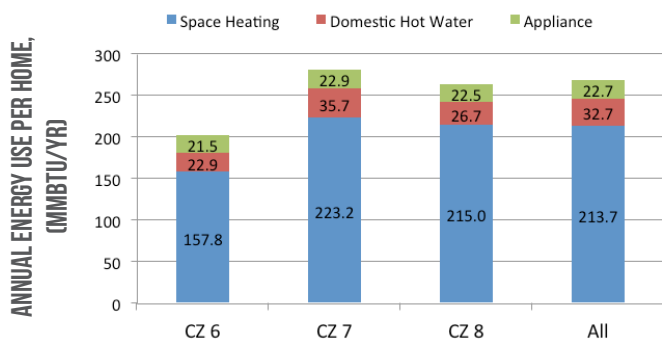


Figure 3 shows the breakdown of major energy uses (space heating, domestic hot water, and appliance energy use) in MMBTUs for all climate zones for the Railbelt and SEAK regions. Climate Zone 6 has significantly less space heating and domestic hot water energy use than Climate Zones 7 and 8.

FIGURE 4

Total energy use per home for major energy uses by residence type (pop wt, MMBTU)

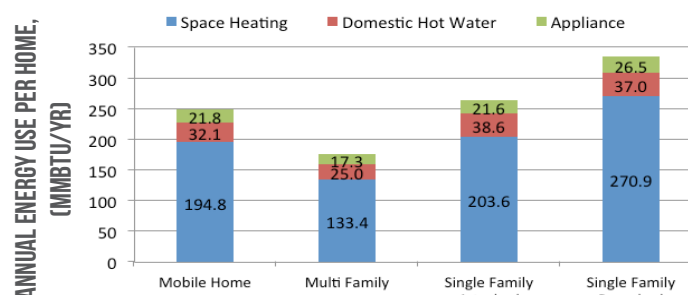


Figure 4 shows space heating, domestic hot water and appliance energy uses for each residence type for all Climate Zones in the Southeast and Railbelt. Single family detached homes use the largest absolute and relative amount of total energy to heat the home and multifamily the least. The relative amount of energy used to operate appliances, including primary cooking and lighting, is approximately the same (between 8-10%) in all types of residences.

FIGURE 5

Total energy use intensity for major energy uses by residence type (ARIS, pop wt, kBtu/ft²)

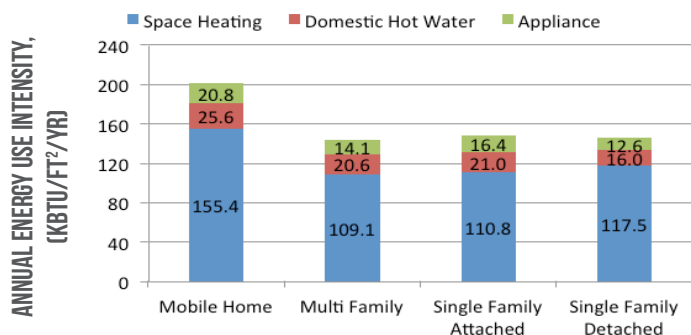
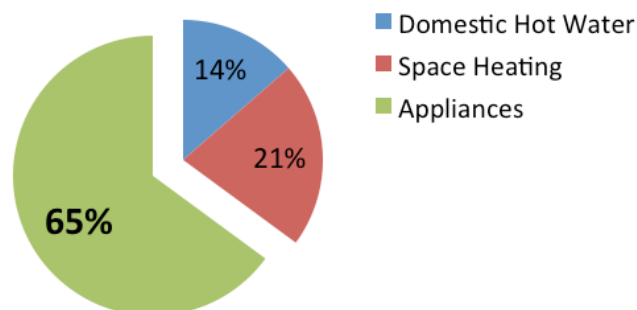


Figure 5 compares the average energy intensity per home in kBtu/ft² for each residence type. Mobile homes have the largest average energy use intensity of the four residence types while the other three residence types are very similar. Space heating energy use intensity in particular is significantly larger for mobile homes than for other residence types. The space heating and domestic hot water energy use intensities for multifamily and single family attached homes relied on the same housing type definition from the ARIS data (the ARIS database does not distinguish between these residence types). Differences in intensities between the two are due to population difference in residence types across Climate Zones.

FIGURE 6

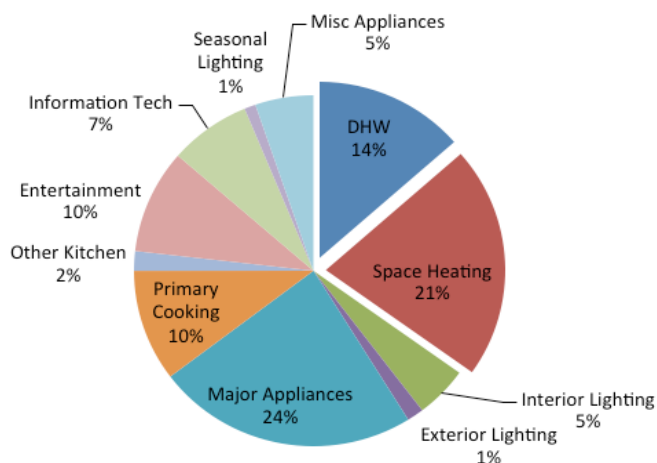
Appliance energy use by major uses (pop wt, % MMBTU)



Appliance energy use accounts for 8% of total energy use for all fuel types, but as shown in Figure 6, appliances consume 65% of total electricity use. Appliances include all lighting, electrical and non-electrical appliances and equipment not related to space heating or hot water heating.

FIGURE 7

Total electricity use for the Railbelt and Southeast by end use (pop wt, % MMBTU)



Major appliances are the largest energy consuming appliance end use for all Climate Zones. This is followed by primary cooking.

FIGURE 8

Total appliance energy by end use by residence type (pop wt, MMBTU)



Figure 8 shows total appliance energy use (all fuel types) per home by appliance end use for by residence type. Mobile homes have the largest primary cooking and entertainment energy use. Single family detached homes have the largest major appliances, interior lighting and miscellaneous appliance energy use. Other end uses are very similar across residence types. The breakdown of appliance energy by appliance end uses across Climate Zones showed little variation.

RAILBELT AND SOUTHEAST NON-RESIDENTIAL ENERGY USE

This study presents the newest available information on non-residential energy use in Alaska. Major conclusions include the following:

- Based on average energy use by various non-residential building types, Railbelt and SEAK regions use over 29,974,000 MMBTUs of energy each year.
- It is important to estimate both the total energy use in MMBTUs and the energy intensity in kBTUs per square foot.
- Food service facilities have more energy intensity than any other type of building in Climate Zones 6, 7, and 8.
- Health care facilities have the second highest energy intensity, about one half that of food service buildings.
- Heating accounts for just over 50% of total building energy used.
- Primary cooking is the second highest energy use for all fuel types, at 26%.
- Lighting uses the largest proportion of energy (28%) in non-residential buildings in all three Climate Zones.
- Lighting has the highest energy intensity of non-residential end use, at 36% of all kBTUs.
- Laundry services in health care facilities are a major use of energy.
- Lighting is the highest use of energy in retail buildings, using over half of all of the energy consumed in MMBTUs.
- While total non-residential energy use is higher in more northerly Climate Zones, it appears to be lower when energy intensity is measured.



FIGURE 9

Total non-residential energy use in the Railbelt and Southeast by Climate Zone

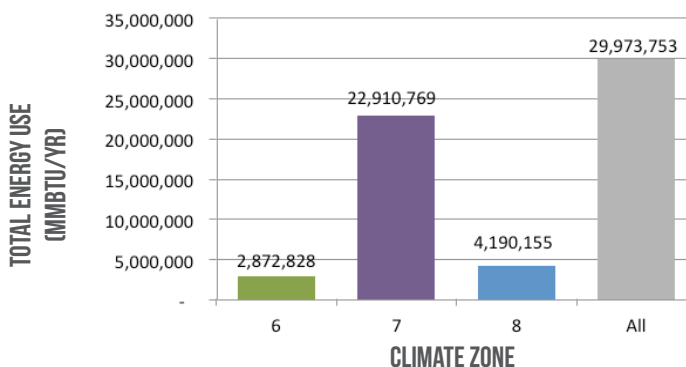


Figure 9 shows the total non-residential building energy use for each of the Climate Zones in the study area. Climate Zone 7 contains the largest number of non-residential buildings and accounts for the largest percentage of non-residential building energy use.

FIGURE 10

Average non-residential building energy intensity by Climate Zone

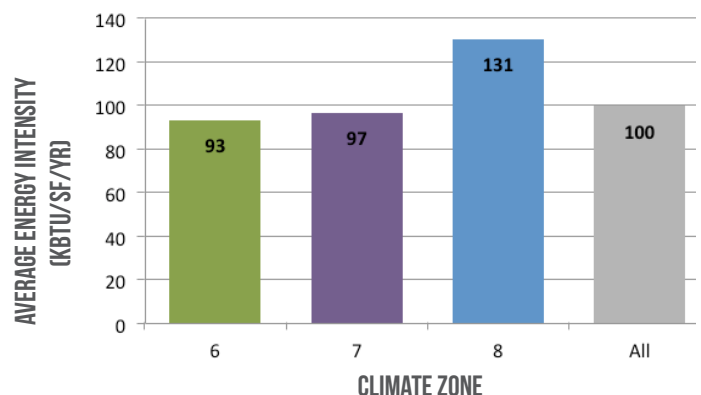


Figure 10 shows similar data, but represents the average non-residential building energy intensity (kBTU/ft²/year) for each Climate Zone and the entire study area. Climate Zone 8 is the most extreme and buildings use the most energy per square foot.

FIGURE 11

Fuel type by Climate Zone

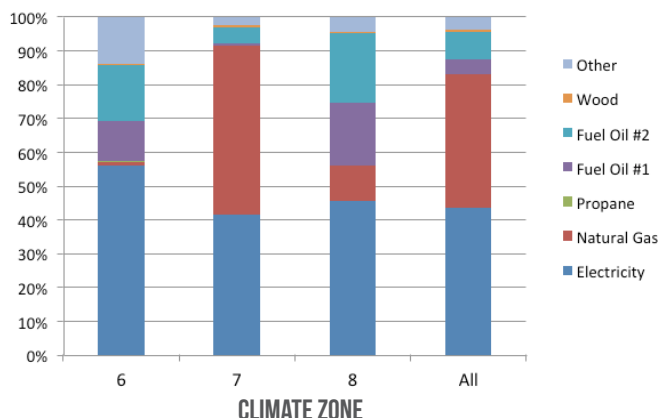


Figure 11 shows similar data of fuel type by Climate Zone. Climate Zone 7 (Anchorage area) has a large penetration of natural gas, while the other Climate Zones do not and rely on other fuel types.

FIGURE 12

Total building energy use and area by building type

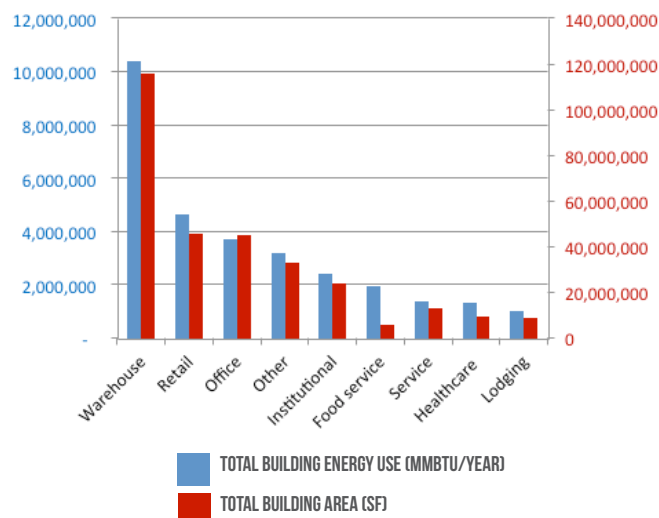


Figure 12 shows the total Railbelt and SEAK non-residential building energy use broken down by building type (blue bars, read from left axis). Warehouse type buildings use the largest amount of energy. Also plotted is the total building area by building type (red bars read on right). The total building energy use correlates to total building area for each building type.

FIGURE 13

Average building energy intensity by building type for all Climate Zones

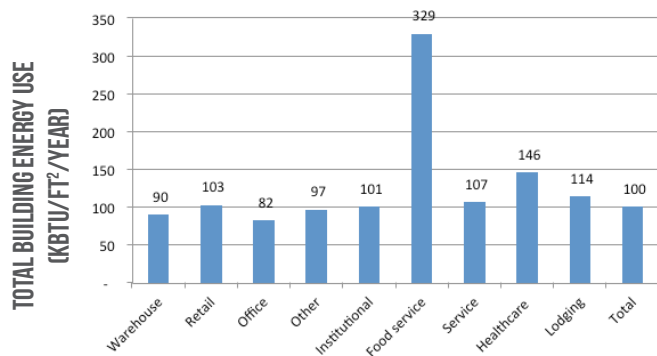


Figure 13 shows average energy intensity (kBTU/SF) for all Climate Zones by building type. Food service is the most energy intensive building type due to cooking energy. Health care facilities are the second most energy intensive building type.

FIGURE 14

Total appliance energy by end use by residence type (pop wt, MMBTU)

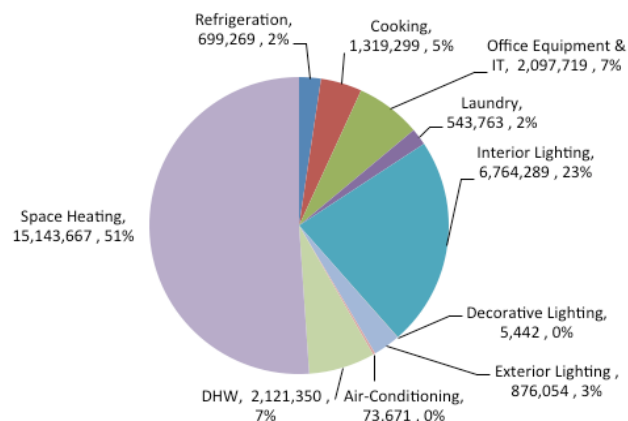
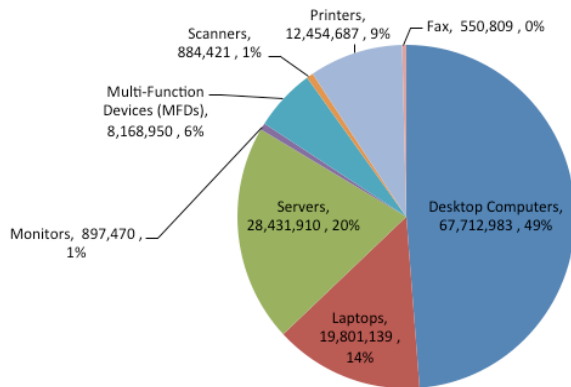


Figure 14 shows total building energy use by primary end-use categories for all non-residential buildings in the Railbelt and SEAK. Total annual energy consumption (MMBTU) and percent of the total non-residential energy use is shown. Heating accounts for just over 50% of the total building energy use, followed by interior lighting (23%), domestic hot water heating (DHW), and office equipment.

FIGURE 15

Total non-residential computer and IT electricity use (kWh/year), Climate Zones 6, 7 and 8



ENERGY USE IN RURAL ALASKA

Residential, non-residential energy use and water and wastewater use data are provided for Bethel and three rural communities.

- Bethel is estimated to use almost 1.3 million MMBTUs of energy per year.
- Oil is the primary heating fuel for Bethel residential use.
- On average, Bethel residents use almost 250 MMBTUs of energy each year in home heating, domestic hot water, and the operation of electrical appliances.
- Space heating uses 72% of all energy among Bethel residences.
- Operating major appliances uses 35% of all electrical energy in Bethel households.
- Office buildings in Bethel use more energy and MMBTUs than any other type of facility.
- Food service facilities have the highest energy intensity, at 335 kBTUs per square foot of any building type.
- Almost three quarters (72%) of all energy used by non-residential buildings in Bethel is used for heating, ventilation and air-conditioning.
- Space heating is the dominant use of energy in all building types except food service buildings.
- Together, the three rural communities included in the rural study use about 107 MMBTUs of energy per year.
- Almost 90% of all energy used in the three communities is for space heating.
- There are differences in the distribution of residential energy use between communities.
- Non-residential heating requires more energy in MMBTUs (72%) than any other application.



WIND POWER PROJECTS - KOTZEBUE, WALES AND SELAWIK

FIGURE 16

Distribution of Rural Building Types

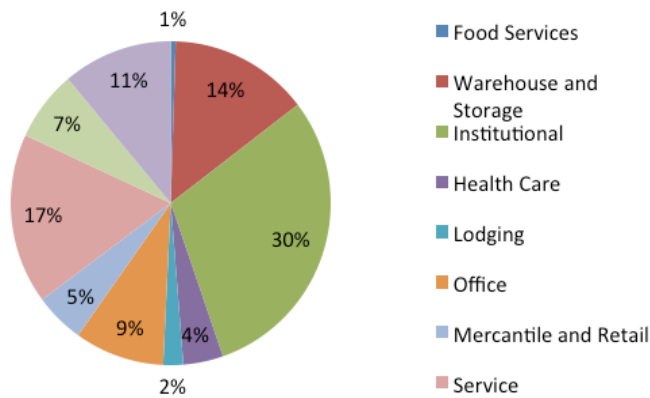


Figure 16 depicts the percentages of the types of all rural buildings included in the study. Institutional buildings represent 30% of all buildings included in the study, while only 1% of the buildings are in the food services category. The building type and sub-types were not recorded for 11% of the buildings in the study.



Overall, the average resident in Bethel uses 193 MMBTUs of energy each year for home heating, providing domestic hot water, and operating appliances. Families living in mobile home residences appeared to use the most energy, at 334 MMBTUs per year. Families living in multi-family residences use the least amount of energy. By far, more energy is spent in home heating than for any other purpose.

TABLE 1

Summary of Bethel residential energy use in MMBTUs/yr

RESIDENCE TYPE	SPACE HEATING	DOMESTIC HOT WATER	APPLIANCES, LIGHTING, ETC.	TOTAL
Mobile Home	280.24	34.32	19.92	334.47
Multi Family	95.30	30.91	17.63	143.83
Single Family Attached	99.42	32.25	20.15	151.82
Single Family Detached	126.92	34.51	20.83	182.07
TOTAL	139.22	33.79	20.24	193.12

FIGURE 17

Summary of Residential Energy Use in Bethel in MMBTUs/yr

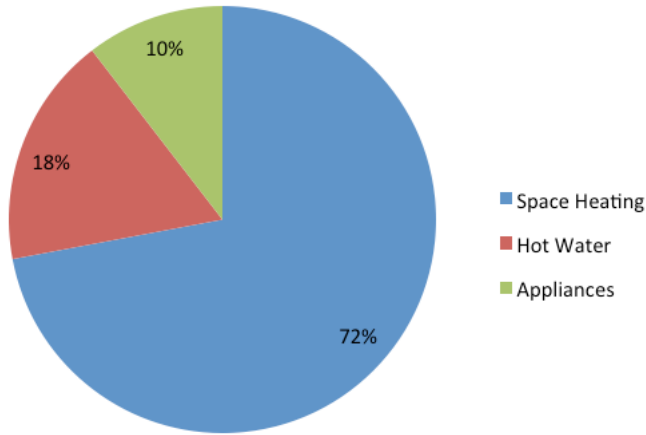
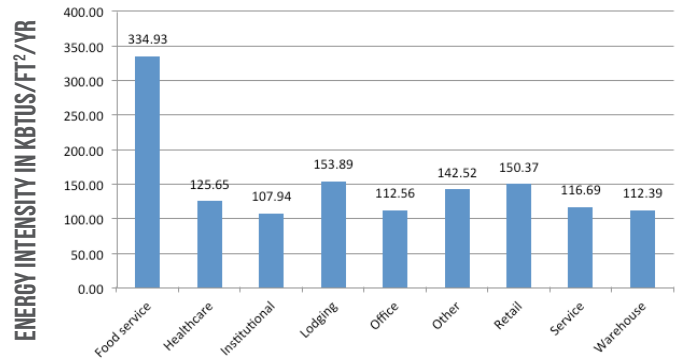


Figure 17 shows the overall distribution of residential energy use. Almost $\frac{3}{4}$ (72%) of all energy is used in home heating. The remainder is distributed between domestic hot water (18%) and the operation of appliances, lighting and other plug loads. (10%).

FIGURE 18

Energy Intensity in kBtUs /ft²/yr, Bethel.



When the energy intensity of buildings in Bethel is analyzed by dividing total energy use by the square foot of each facility, food service buildings are the highest energy users. Other building types have similar per-square-foot energy usage, between 107 and 150 kBtUs per square foot

FIGURE 19

Distribution of Total energy use in MMBTUs/yr, Bethel

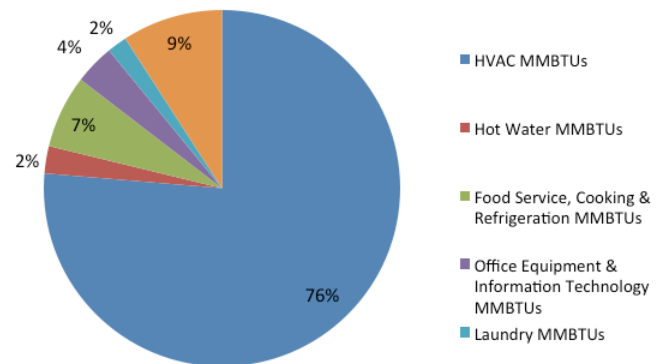


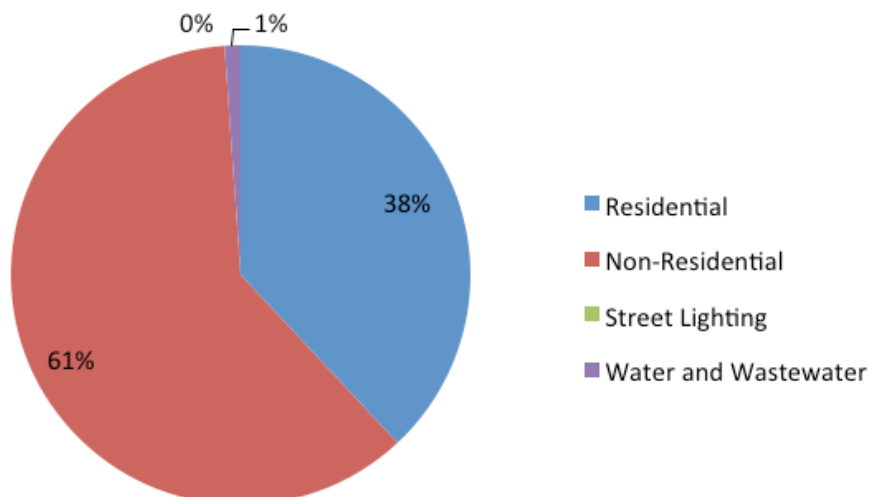
Figure 19 shows that over three quarters (76%) of all energy used by non-residential buildings in Bethel is used to heat the facility. This second highest use is in interior and exterior lighting (9%). All other energy uses comprise about 15% of all MMBTUs.

PHOTO COURTESY OF CITY-DATA.COM

TABLE 2: SUMMARY OF BETHEL ENERGY USE

COMPONENT	UNITS	MEAN USE (MMBTU/YR)	TOTAL (MMBTUS/YR)
Residential	2364	193.1	456,488.4
Non Residential			729,925.3
Food Service	8	528.74	4,229.9
Warehouse	14	586.65	8,213.2
Institutional	44	621.60	27,350.4
Health Care	4	492.85	1,971.4
Regional Administration (60,000 ft ²)	1	1,251.65 kBTU/ ft ²	75,099.0
Hospital (115,000 ft ²)	1	4,411.26 kBTUs/ ft ² /yr	507,294.9
Lodging	5	817.08	4,085.4
Office	40	1368.97	54,758.9
Mercantile/retail	15	838.78	12,581.7
Service	60	550.52	33,031.2
Other	5	267.91	1339.6
Total	197		
Street Lighting			2.6
Water and Waste Water (50)			13,463.0
Total			1,199,879.4

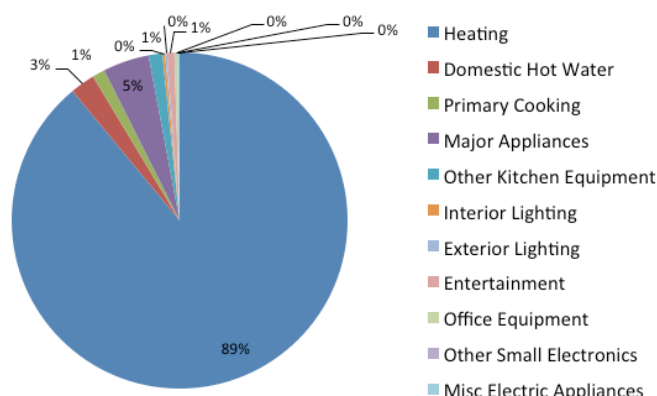
FIGURE 20: DISTRIBUTION OF TOTAL ENERGY USE IN BETHEL



RURAL VILLAGE COMMUNITIES

FIGURE 21

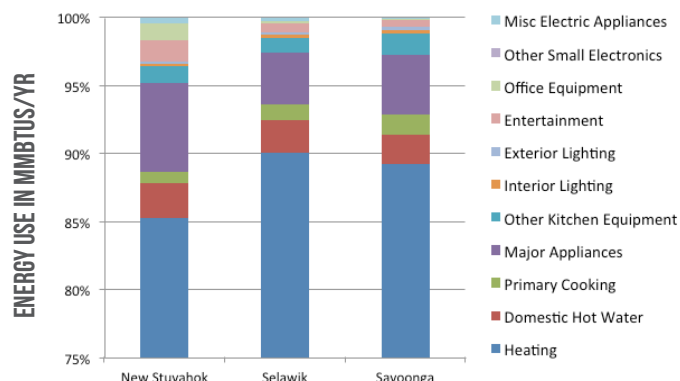
Distribution of Total energy use in MMBTUs, Three Small Communities



The communities of New Stuyahok, Savoonga and Selawik were identified for detailed end-use energy analysis. Almost 90% of total residential energy is used for home heating. Another 5% is used for major appliances.

FIGURE 22

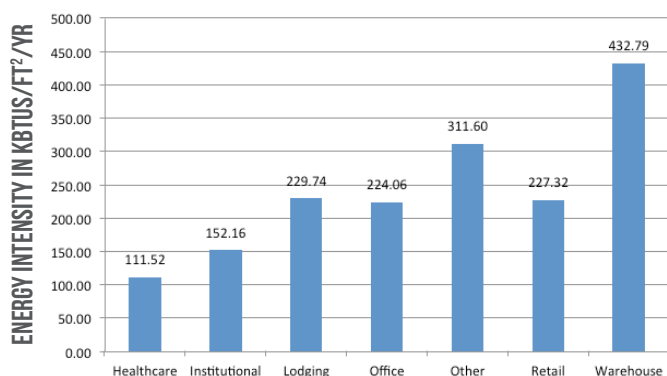
Distribution of energy use by building type, MMBTUs/yr, Three Small Communities



The energy intensity results are similar in each community. Heating is the largest energy use in the three communities. This may be attributable to the similar square footage of average houses in the three communities.

FIGURE 23

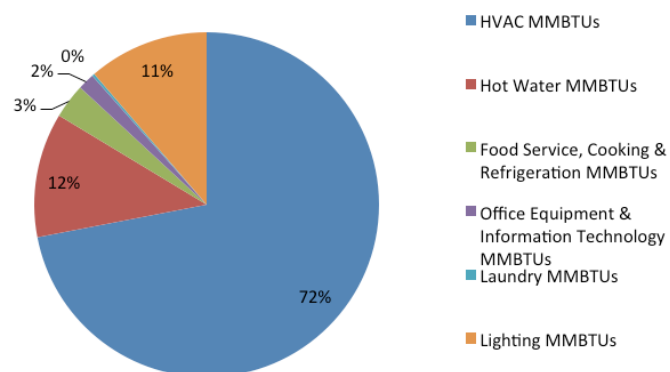
Energy Intensity in kBTUs/ft²/yr, Three Small Communities



The energy intensity, or energy per square foot, mirrors the overall energy use largely due to the similar average square footage of homes as found in these communities. While all three communities dedicate a large portion of energy to home heating, Savoonga uses a significantly greater amount of energy per square foot than the other communities in heating, domestic hot water, primary cooking, major appliances and other kitchen equipment. New Stuyahok appears to be a greater user of energy for entertainment and office equipment.

FIGURE 24

Distribution of Total energy use in MMBTUs/yr, Three Small Communities



As with residential uses, heating requires more energy in MMBTUs/yr (72%) than any other application. The production of hot water is second (12%), followed by the operation of the interior and exterior lighting (11%)