

Residential Heating Projects

for the Arctic Renewable Energy Working Group

Dec 09, 2016

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Research • Innovation • Education



COLD CLIMATE HOUSING RESEARCH CENTER

CCHRC

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THE SUSTAINABLE VILLAGE @ UAF

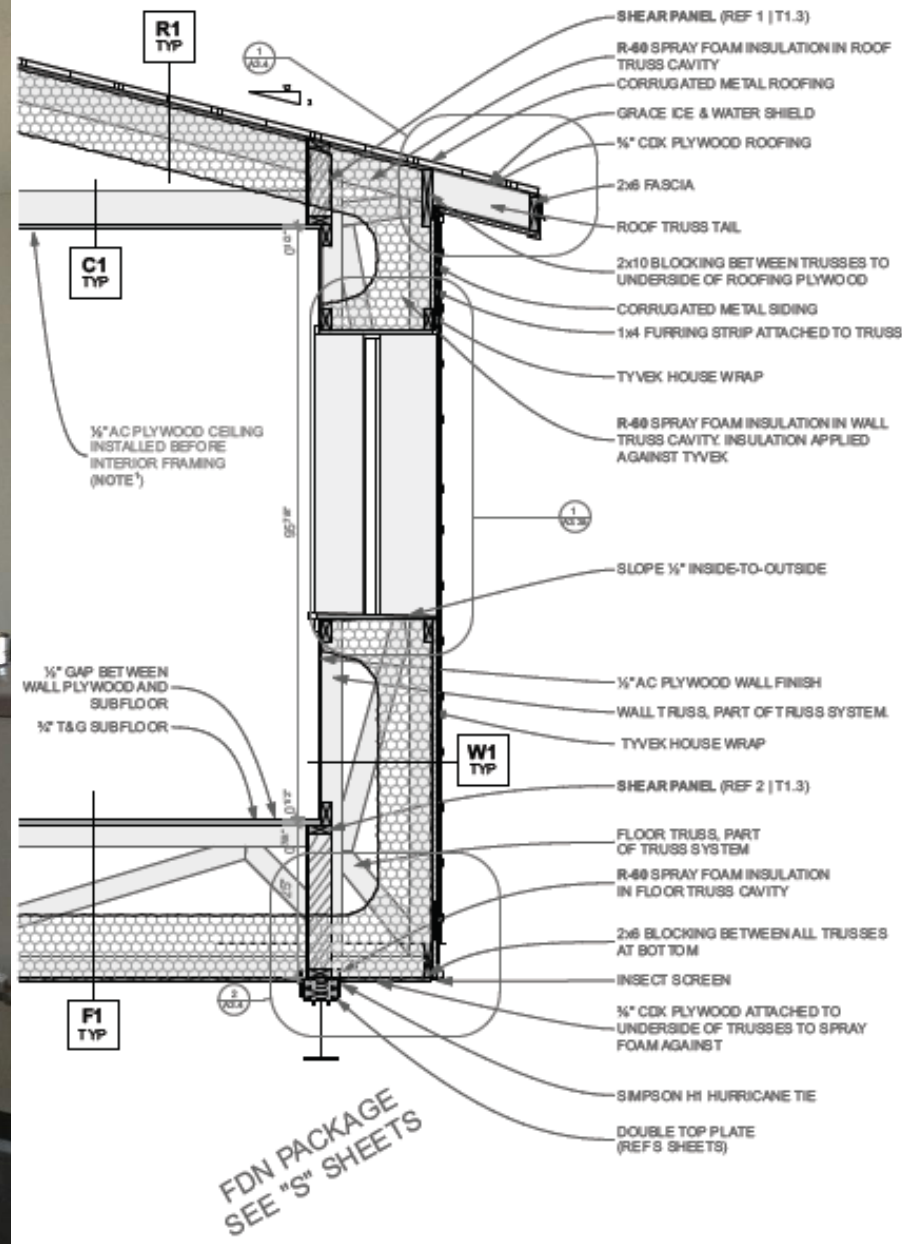




ATMAUTLUAK







EAVE WALL SECTION



The Association of Village Council Presidents
BETHEL TRUSS PLANT
 Conceptual Design Drawing Set



COLD CLIMATE HOUSING RESEARCH CENTER

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PROJECT LOCATION: BETHEL, ALASKA



DRAWING SHEET INDEX

| | |
|-----|-----------------------------|
| G-1 | TITLE SHEET |
| A-1 | SITE FOUNDATION PLAN |
| A-2 | LEVEL 01 PLAN [PROPOSED] |
| A-3 | LEVEL 02 PLAN |
| A-4 | TRUSS PLANT LAYOUT + EQUIP. |
| A-5 | ELEVATIONS |
| A-6 | SECTION |
| A-7 | ASSEMBLY TYPES |

**BETHEL TRUSS PLANT
 CONCEPTUAL DESIGN SET**

DATE: JULY 01 2016

PAGE NOTES:

TITLE SHEET

G-1

PAGE 1 of 8

COLD CLIMATE HOUSING RESEARCH CENTER
 1000 FAIRBANKS STREET
 FAIRBANKS ALASKA 99709
 PHONE 907 457 3454
 www.cdtrc.org



Home Energy Rating Certificate

UNOFFICIAL



The Home Located At:

Lot 1 Block 3, Sunrise Subdivision
Fairbanks, Alaska

Has Been Energy-Rated As:



Six Star

Breakdown of Costs, \$ Per Year

| | |
|-----------------|-------|
| Floor | \$47 |
| Wall/Door | \$139 |
| Window | \$192 |
| Ceiling | \$31 |
| Air/Vent | \$112 |
| Htg System Loss | \$203 |
| Hot Water | \$366 |
| Cooling | \$0 |
| Lights/Appl. | \$930 |
| Renewables | \$0 |

Efficiency Score

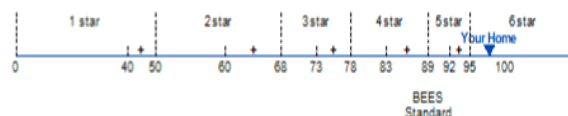
97.7 points

Renewables Bonus

0.0 points

Combined Score

97.7 points



Amount of CO2 Produced by the Home

10,610 pounds per year

Projected Annual Energy Costs

\$2,021 per year

Client: Bruno Grunau Rater: BCG Date: 5/6/2012

Rater's City: Contact:

ver. 2.6.1.0, library: 8/9/2016, file: Keystone House 2013 7-12-16 - updated.hm2, Rating Type: From Plans

I certify that this Rating is true and correct, to the best of my knowledge and belief:

Rater Signature

Energy Cost and Features Report (DOCUMENT DOES NOT NEED TO BE RECORDED)

Property: Bruno Grunau
Lot 1 Block 3, Sunrise Subdivision
Fairbanks, Alaska

Rater: BCG

House: Single Family
Living Floor Area: 1,450 square feet
No Attached Garage

Rating: From Plans

Envelope Efficiency

| | |
|------------------------------------|---|
| Floor Insulation | R-72.1 * |
| Wall/Door Insulation | R-61.9 * |
| Ceiling Insulation | R-111.8 |
| Window U-Value | U-0.29 |
| Window SHGC | 0.51 |
| Window to Wall Ratio, Living Space | 12.0% |
| South Facing Window Area | 112 square feet |
| Air Leakage | 0.4 Air Changes per Hour at 50 Pascals 0.03 Air Changes per Hour Natural |

* Includes the insulating value of the ground in contact with these components.

Space Heating System

| | |
|-------------------------------|----------------|
| Fuel | Spruce Wood |
| System Type | Direct |
| Model | |
| Efficiency | 72% |
| Btu/hr Output | Btu/hr |
| Primary Htg. Sys. Design Load | 18,879 Btu/hr |
| Garage Htg. Sys. Design Load | 0 Btu/hr |
| Supplemental Fuel | None |
| Thermostat Setting | 70.0 degrees F |
| Setback Thermostat | None |

Water Heater

| | |
|------------|-------------------|
| Efficiency | 50% |
| Location | Conditioned Space |
| Fuel Type | Spruce Wood |

Space Cooling System

None Present

Ventilation

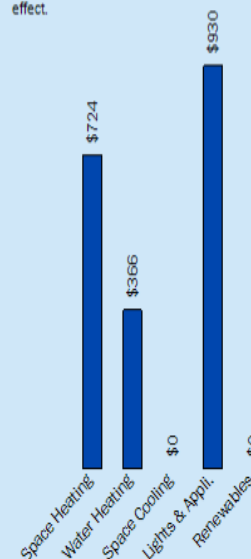
| | |
|----------------------|--------------------------|
| System Type | Heat Recovery Ventilator |
| Required Ventilation | 55 CFM |
| Measured Ventilation | 120 CFM |

Other

| | |
|------------------------------------|-------------|
| Number of Bedrooms | 3 |
| Clothes Dryer Fuel | None |
| Cooking Range Fuel | Electricity |
| Oven Fuel | Electricity |
| Miscellaneous Lights/Appliance Use | Low |
| CAZ Test Normal Conditions | Pass |

Estimated Annual Energy Costs

Actual use and costs may vary from these estimates depending upon weather conditions, occupant life styles and utility rates currently in effect.



Electricity: \$0.2/kWh, Spruce Wood:
\$250/cords
Space Heating: 2.90 cords of Spruce
Wood
Water Heating: 1.47 cords of Spruce
Wood
Space Cooling:
Lights & Appliances: 4,654 kWh of

AkWarm Actual vs. Modeled

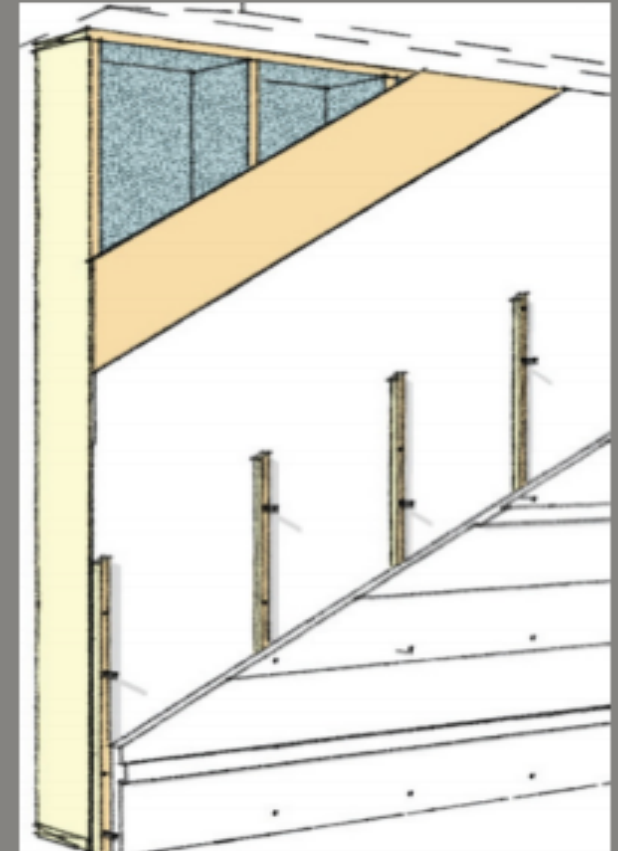
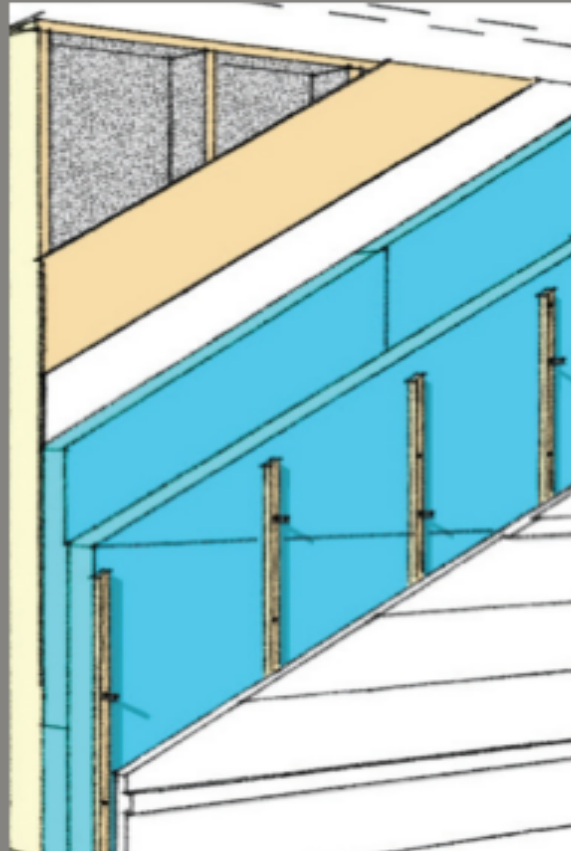
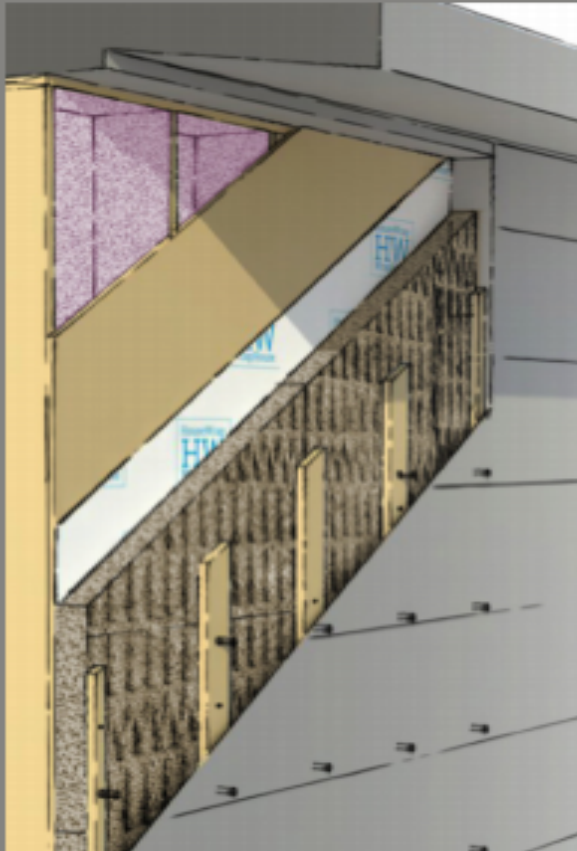
Description:

Examining the accuracy of AKWarm's fuel use estimates and the factors that might influence that accuracy will require examining a large number of homes. In Phase I of the study we will examine existing fuel bills and home rating data from 308 Southcentral homes. Phase I will also include the retrieval of additional data from other communities. Analysis of the new data will comprise Phase II.

An ongoing Enstar study of homes in the Anchorage area looked at fuel bill data of actual gas consumed by 308 homes that had received AKWarm home ratings. All these homes have fuel usage records both before and after their retrofit. We propose to compare the individual home gas use estimates from the rating data in the ARIS database to the actual gas use, both pre-and post-retrofit. We will examine the factors that affect the accuracy of the estimates, including home age, energy rating, home size, construction components, house type, presence of a garage, and rater number.

Safe
Effective &
Affordable

RETROFITS





2014 ALASKA HOUSING ASSESSMENT

[Region](#)

[Census Area](#)

To select portions of the report for download, either use the checkboxes on the right or click on the map areas



Report Selections

Statewide Report

☐ Statewide

Appendices

- ☐ A: ACS Cost Estimate Analysis
- ☐ B: Statewide Need Assessment
- ☐ C: Data Limitations
- ☐ D: Methodology Flowchart (image)
- ☐ D: Methodology Overview
- ☐ E: Chart Folio

ANCSA Regions

- ☐ Ahtna, Inc.
- ☐ Aleut Corporation
- ☐ Arctic Slope Regional Corporation
- ☐ Bering Straits Native Corporation
- ☐ Bristol Bay Native Corporation
- ☐ Calista Corporation
- ☐ Chugach Alaska Corporation
- ☐ Cook Inlet Region, Inc.
- ☐ Doyon Limited
- ☐ Koniag, Inc.
- ☐ NANA Regional Corporation
- ☐ Sealaska Corporation

Census Areas

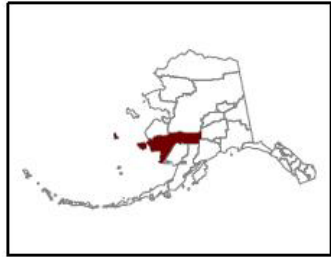
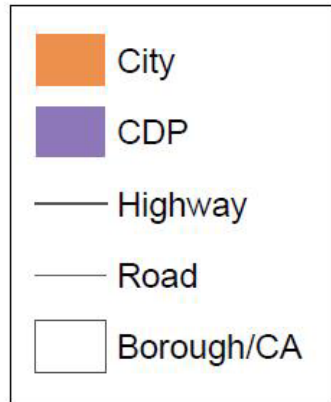
- ☐ Aleutians East Borough
- ☐ Aleutians West
- ☐ Anchorage Municipality
- ☐ Bethel
- ☐ Bristol Bay Borough
- ☐ Denali Borough
- ☐ Dillingham
- ☐ Fairbanks North Star Borough
- ☐ Haines Borough
- ☐ Hoonah-Angoon
- ☐ Juneau City and Borough
- ☐ Kenai Peninsula Borough
- ☐ Ketchikan Gateway Borough
- ☐ Kodiak Island Borough
- ☐ Lake and Peninsula Borough
- ☐ Matanuska-Susitna Borough
- ☐ Nome
- ☐ North Slope Borough
- ☐ Northwest Arctic Borough
- ☐ Petersburg
- ☐ Prince of Wales-Hyder
- ☐ Sitka City and Borough
- ☐ Skagway Municipality
- ☐ Southeast Fairbanks
- ☐ Valdez-Cordova
- ☐ Wade Hampton
- ☐ Wrangell City and Borough
- ☐ Yakutat City and Borough
- ☐ Yukon-Koyukuk

Select All

Clear All

Download as ZIP

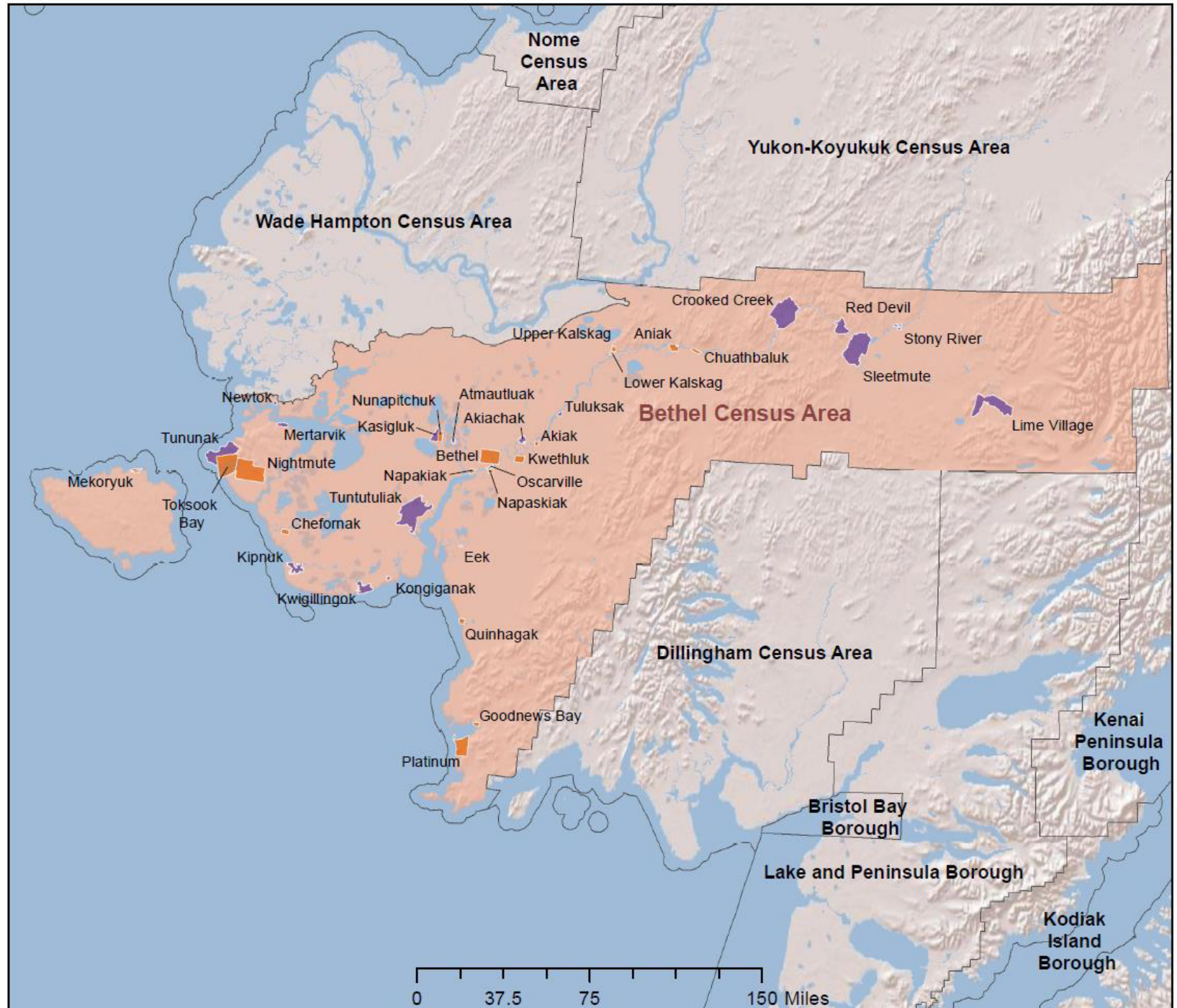
Bethel Census Area



Prepared by:
Alaska Department of Labor
& Workforce Development

September 2011

Source: US Census
2010 TIGERline



Bethel Census Area Dashboard

Population: The Alaska Department of Labor and Workforce Development's current (2012) population estimate for the Bethel Census Area is 17,600—an increase of 10% from 2000.

Housing Units: There are currently 5,884 housing units in the Bethel Census Area. Of these 4,295 are occupied, 253 are for sale or rent, and the remaining 1,336 are seasonal or otherwise vacant units (Profile Figure C6).

Energy: The average home in the Bethel Census Area is 944 square feet and uses 155,000 BTUs of energy per square foot annually, 13% more than the statewide average of 137,000 BTUs per square foot per year.

Energy Costs: Using AKWarm estimates, average annual energy cost for homes in the Bethel Census Area is \$6,440, which is approximately 2.3 times more than the cost in Anchorage and 3 times more than the national average (Profile Figure C13).

Energy Programs: Approximately 17% of the occupied housing in the Bethel Census Area has completed either the Home Energy Rebate, Weatherization, or BEES programs since 2008, compared to 21% statewide (Profile Figure C12).

Housing Quality: Within current housing stock, newer homes have better energy performance. On average, homes built in the 1960s are currently rated at 1-star-plus, compared to a current average rating of 4-stars for houses built after 2000.

Air-tightness: Within current housing stock, newer homes are tighter. On average, homes built in the last decade very nearly meet the 2012 BEES standard of 4 air-changes per hour at 50 pascals (ACH50). In contrast, homes built in the 1960s are 2.4 times leakier than those built since 2000 (Profile Figure C7).

Ventilation: An estimated 1,303 occupied housing units (or 30%) in the Bethel Census Area are relatively air-tight and lack a continuous ventilation system. These houses are at higher risk of moisture- and indoor air quality-related issues (Profile Figures C9-C10).

Overcrowding: 36% of occupied units are estimated to be either overcrowded (16%) or severely overcrowded (20%). This is roughly 11 times the national average, and makes the Bethel Census Area the third most overcrowded census area in the state.

Affordability: On average, approximately 19% of households in the Bethel Census Area spend more than 30% of total income on housing costs, which include rent, utilities, and energy costs. Based on average AKWarm estimates, annual energy costs constitute approximately 12% of census median area income for occupied housing.

Census Area Profile for: Bethel Census Area

ANCSA Region: Calista

Regional Housing Authority: AVCP Regional Housing Authority

BEES Climate Zone (Heating Degree Day Range) Zone 8 (12,600 - 16,800 HDD)

COMMUNITY - Bethel Census Area

Figure C1: Existing Housing by Decade Built

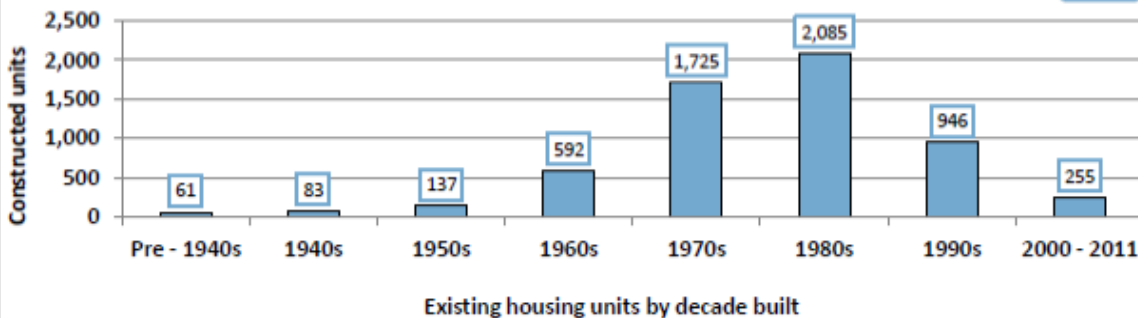


Figure C2: Population

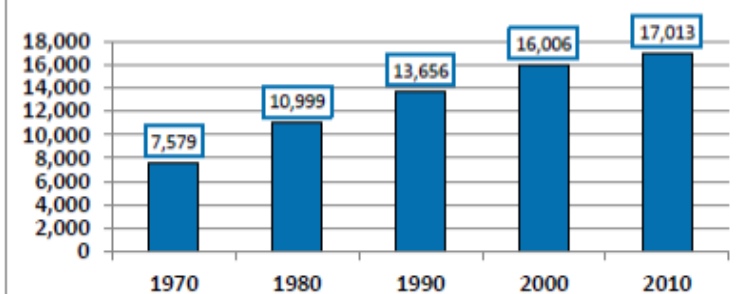


Figure C3: Trends in Housing Unit Size

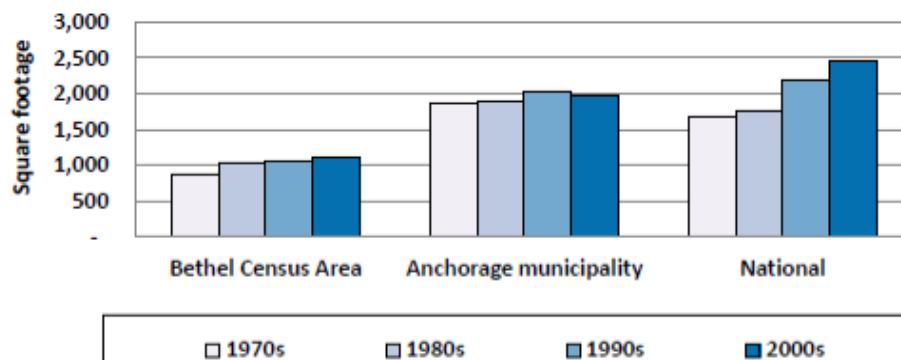
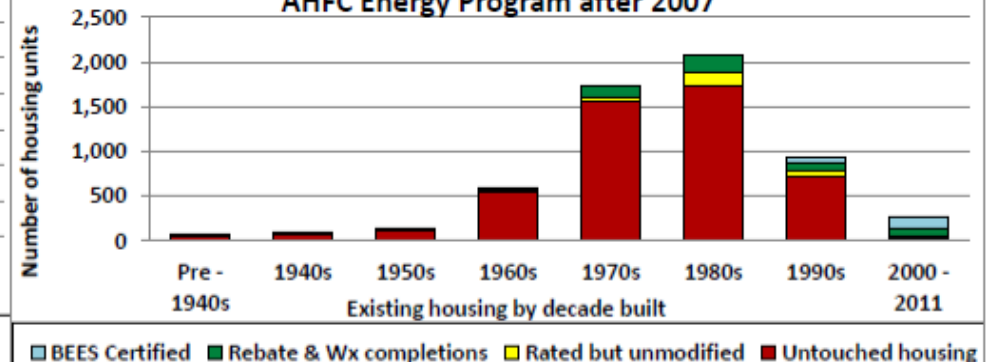


Figure C4: Housing Units Completing an AHFC Energy Program after 2007



| Houses Lacking Complete Plumbing or Kitchen Facilities | Households | |
|--|------------|---------|
| | Number | Percent |
| Lack complete plumbing | 1,739 | 41% |
| Lack complete kitchen | 1,366 | 32% |

| | |
|------------------------------------|---------|
| Avg Annual Energy Cost with PCE | \$6,442 |
| Avg Annual Energy Cost without PCE | \$8,395 |

| Weatherization Retrofits (funding increased 2008) | |
|---|-------|
| Date Range | Units |
| 2008 - 2011 | 505 |
| 2003 - 2007 | 58 |
| 1990 - 2002 | 790 |

| Estimated Total Annual Community Space Heating Fuel Use | | |
|---|-----------|-----------|
| Fuel Oil | 2,337,320 | (gallons) |
| Natural Gas | - | (ccf) |
| Electricity | 1,675,862 | (kWh) |
| Wood | 5,942 | (cords) |
| Propane | 489 | (gallons) |
| Coal | - | (tons) |

| Housing Need Indicators | Number of Units | % Occupied Housing |
|-------------------------|-----------------|--------------------|
| Overcrowded | 1,530 | 36% |
| Housing cost burdened | 744 | 17% |
| 1 Star Homes | 833 | 19% |

| Housing Stock Estimates | Number of Units |
|---------------------------------|-----------------|
| All Housing | 5,884 |
| All Occupied Housing | 4,295 |
| All Vacant housing | 1,589 |
| Vacant Housing for Sale or Rent | 253 |

OVERCROWDING & VENTILATION - Bethel Census Area

Figure C5: Overcrowded Units

ACS

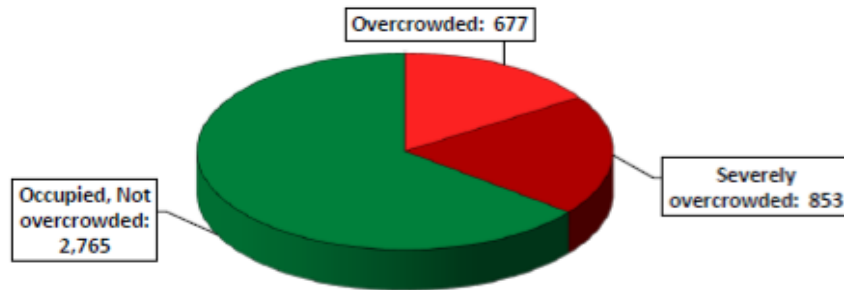


Figure C6: Housing Occupancy

MIX

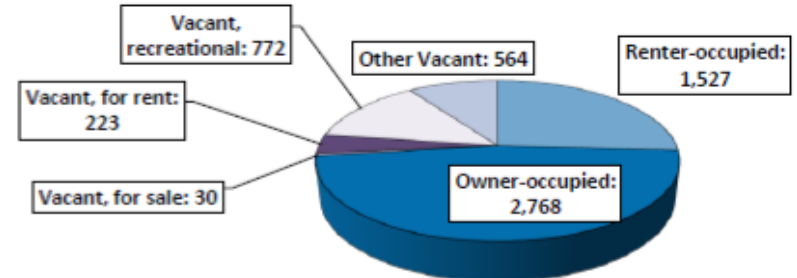


Figure C7: Average Air-Tightness of Current Homes by Decade Built

ARIS

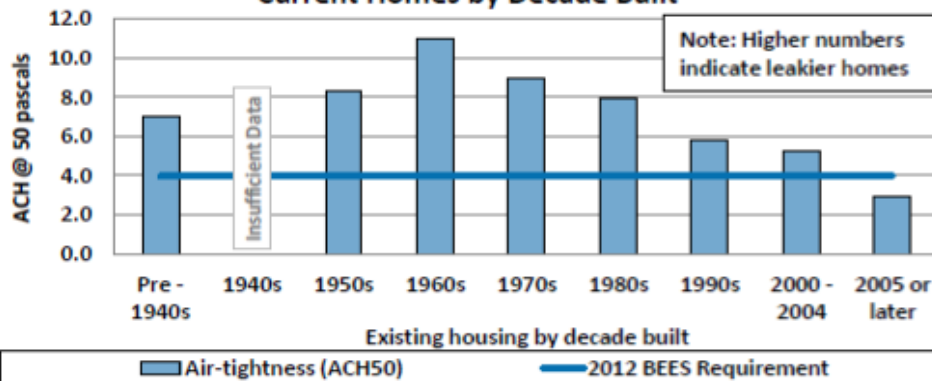


Figure C8: Existing Ventilation Type by Decade Built

ARIS

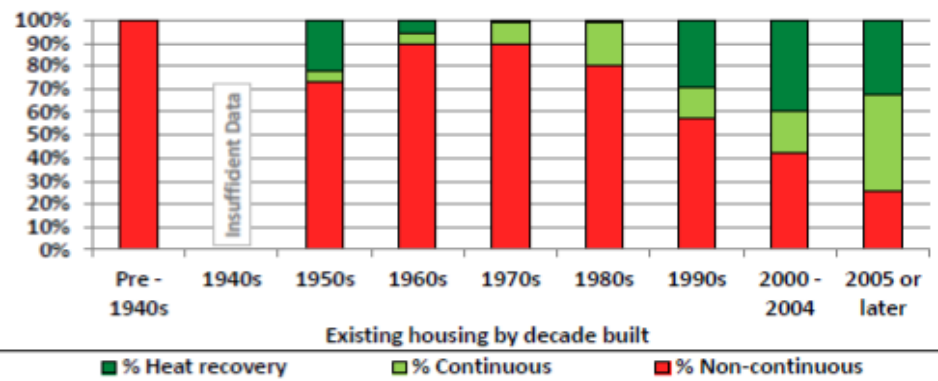


Figure C9: Percent of Housing Stock at High Risk of Moisture and Air Quality Problems

ARIS

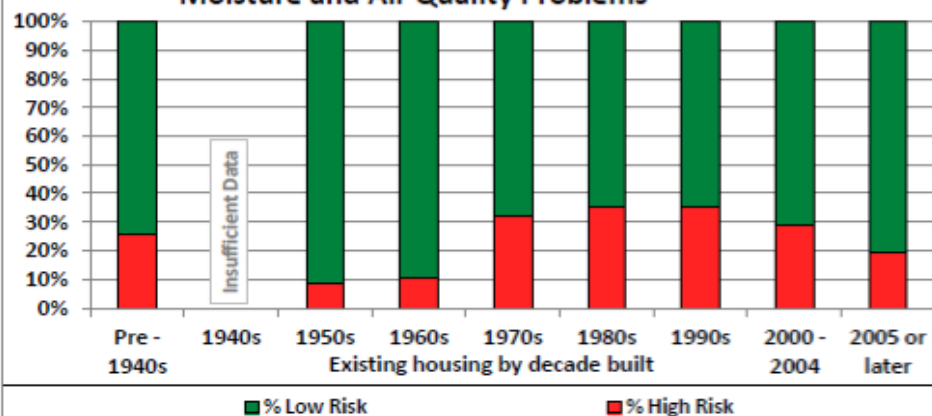
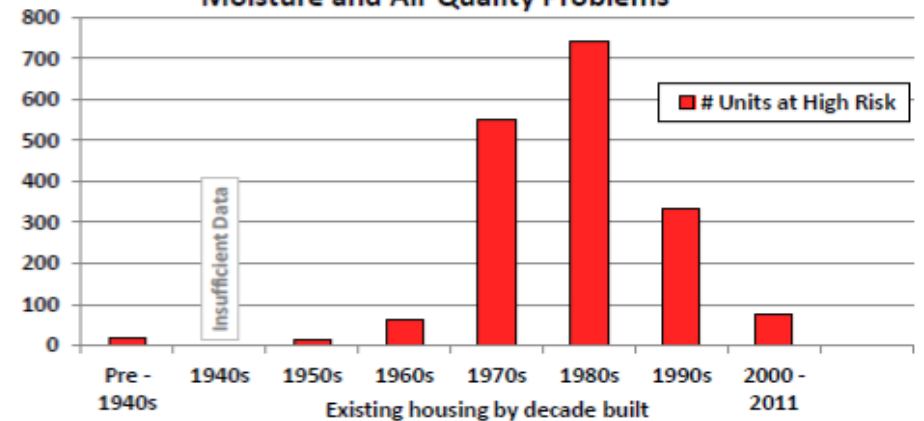


Figure C10: Quantity of Housing Stock at High Risk of Moisture and Air Quality Problems

ARIS



ENERGY - Bethel Census Area

Current Bethel Census Area Housing Energy Characteristics By Decade Built

| Current Residential Units by Year Built | # of AkWarm Records | Avg Energy Rating Stars | Avg Energy Rating Points | Avg Sq. Feet | Avg. Annual Energy Cost (with PCE) | Avg. Annual Energy Use (million BTUs) | Avg Ann Energy by End Use (million Btus) | | | Avg. EUI (kBtus / SF) | Avg. ECI (\$ / SF) | Avg. Home Heating Index |
|---|---------------------|-------------------------|--------------------------|--------------|------------------------------------|---------------------------------------|--|-----|------------|-----------------------|--------------------|-------------------------|
| | | | | | | | Space Heating | DHW | Appliances | | | |
| OVERALL | 1,069 | 2-star plus | 61.3 | 944 | \$6,442 | 135 | 97 | 13 | 23 | 155 | \$7.11 | 9.0 |
| Pre- 1940 | 7 | 2-star plus | 66.4 | 1,628 | \$10,933 | 194 | 137 | 22 | 35 | 116 | \$7.01 | 6.4 |
| 1940- 49 | 4 | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| 1950- 59 | 21 | 1-star plus | 45.0 | 784 | \$5,175 | 95 | 73 | 1 | 20 | 132 | \$7.27 | 7.9 |
| 1960- 69 | 90 | 1-star plus | 41.0 | 596 | \$5,670 | 130 | 104 | 5 | 21 | 217 | \$10.06 | 13.6 |
| 1970- 79 | 297 | 2-star | 58.9 | 880 | \$6,134 | 129 | 96 | 11 | 22 | 159 | \$7.54 | 9.3 |
| 1980- 89 | 609 | 2-star plus | 65.5 | 1,027 | \$6,982 | 145 | 104 | 18 | 24 | 151 | \$7.13 | 8.6 |
| 1990- 99 | 331 | 3-star | 69.2 | 1,062 | \$6,615 | 137 | 89 | 15 | 23 | 135 | \$6.40 | 7.4 |
| 2000- 2004 | 209 | 3-star plus | 77.9 | 1,122 | \$5,572 | 119 | 73 | 22 | 25 | 141 | \$5.42 | 7.7 |
| 2005 or later | 71 | 4-star plus | 87.4 | 1,121 | \$4,839 | 94 | 44 | 26 | 23 | 89 | \$4.52 | 3.4 |

Figure C11: Current Average Energy Use Intensity and Average Square Footage by Decade Built

ARIS

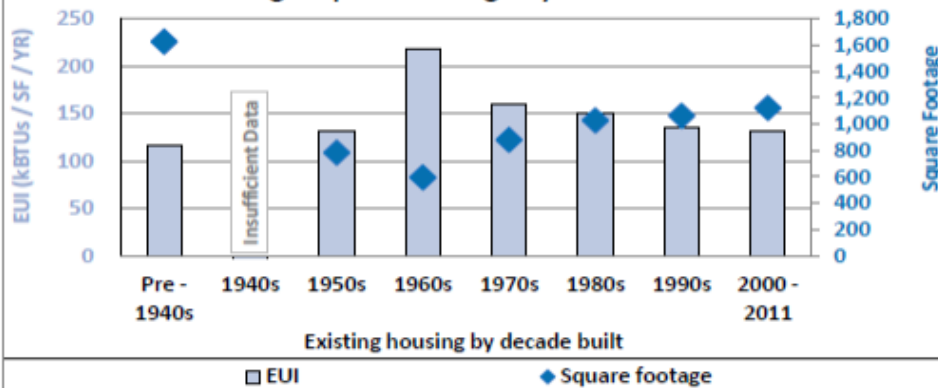
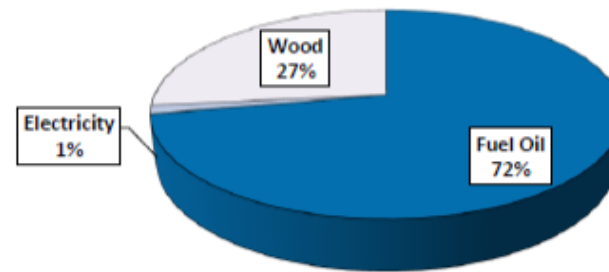


Figure C12: Percent of Total Residential Space Heating Energy by Fuel Type

ARIS



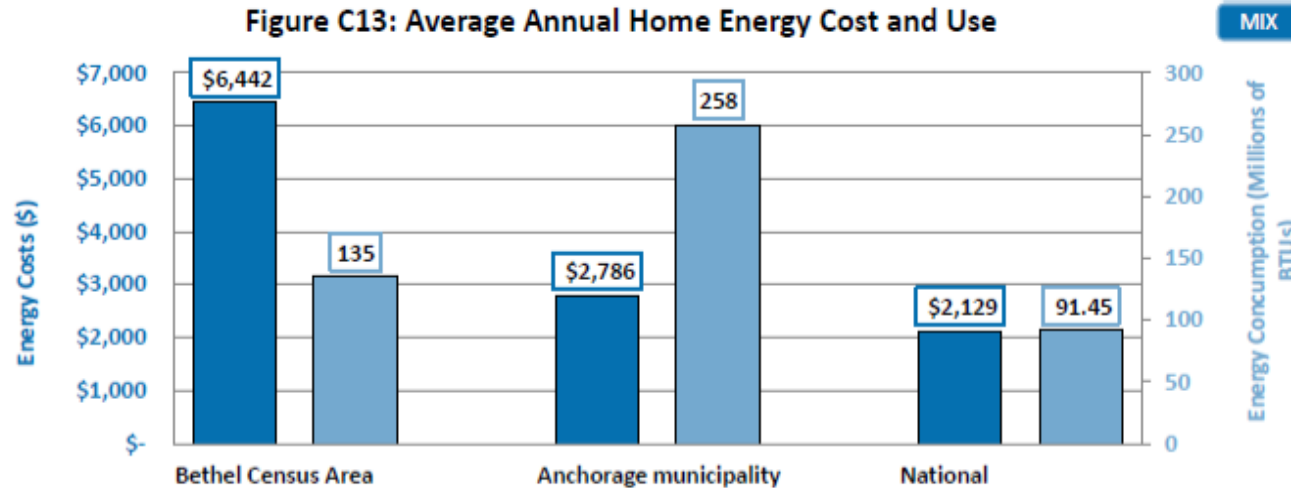
Current Bethel Census Area Housing Envelope Characteristics By Decade Built

| Current Residential Units by Year Built | # of AkWarm Records | ACH 50 | Ceiling R | Above Grade Wall R | Below Grade Wall R | Above Grade Floor R | On Grade Floor R | Below Grade Floor R | Door U | Garage Door U | Window U |
|---|---------------------|--------|-----------|--------------------|--------------------|---------------------|------------------|---------------------|--------|---------------|----------|
| OVERALL | 1,069 | 7.9 | 22 | 16 | 8 | 22 | 3 | 3 | 0.48 | 0.23 | 0.61 |
| Pre- 1940 | 7 | 7.0 | 25 | 20 | NR | 30 | NR | NR | 0.30 | NR | 0.40 |
| 1940- 49 | 4 | NR | NR | NR | NR | NR | NR | NR | NR | NR | NR |
| 1950- 59 | 21 | 8.4 | 18 | 13 | NR | 12 | NR | NR | 0.88 | NR | 0.70 |
| 1960- 69 | 90 | 11.0 | 13 | 12 | NR | 13 | NR | NR | 0.60 | NR | 0.91 |
| 1970- 79 | 297 | 8.9 | 18 | 14 | NR | 20 | NR | NR | 0.57 | NR | 0.64 |
| 1980- 89 | 609 | 7.9 | 25 | 17 | 12 | 26 | NR | NR | 0.42 | 0.18 | 0.58 |
| 1990- 99 | 331 | 5.8 | 25 | 20 | NR | 24 | NR | NR | 0.45 | 0.14 | 0.58 |
| 2000- 2004 | 209 | 5.3 | 26 | 18 | NR | 27 | NR | NR | 0.35 | 0.20 | 0.49 |
| 2005 or later | 71 | 2.9 | 37 | 23 | NR | 38 | NR | NR | 0.22 | NR | 0.34 |

| | | | | | | | | | | |
|----------------------------|-----|----|----|----|----|----|----|------|------|------|
| BEES 2009 - Climate Zone 8 | 7.0 | 38 | 30 | 15 | 38 | 15 | 15 | 0.22 | 0.22 | 0.22 |
| BEES 2012 - Climate Zone 8 | 4.0 | 48 | 30 | 15 | 38 | 15 | 15 | 0.22 | 0.22 | 0.22 |

AFFORDABILITY - Bethel Census Area

Figure C13: Average Annual Home Energy Cost and Use



| Housing Information | Avg Household Size (# of people) |
|---------------------|----------------------------------|
| All-occupied | 3.9 |
| Owner-occupied | 4.2 |
| Renter-occupied | 3.3 |

| Median Value of Owner-occupied House with Mortgage |
|--|
| \$205,200 |

| Median Value of Owner-occupied House without a Mortgage |
|---|
| \$120,100 |

| Median Annual Household Income | |
|--------------------------------|------------------|
| Housing Units | Household Income |
| All-occupied | \$ 52,063 |
| Renter-occupied | \$ 48,860 |
| Owner-occupied | \$ 53,804 |
| w/ mortgage | \$ 90,446 |
| w/o mortgage | \$ 39,547 |

| Median Housing Costs | | |
|--------------------------------|----------|-----------|
| | Monthly | Annual |
| All-occupied | \$ 667 | \$ 8,004 |
| Gross rent | \$ 941 | \$ 11,292 |
| Owner-occupied | \$ 551 | \$ 6,612 |
| Housing units w/ mortgage | \$ 1,411 | \$ 16,932 |
| Housing units w/out a mortgage | \$ 396 | \$ 4,752 |

| Avg % of Median Income Spent on Energy | 12.4% |
|--|-------|
|--|-------|

Figure C14: Affordability - Housing Costs as a Percent of Income

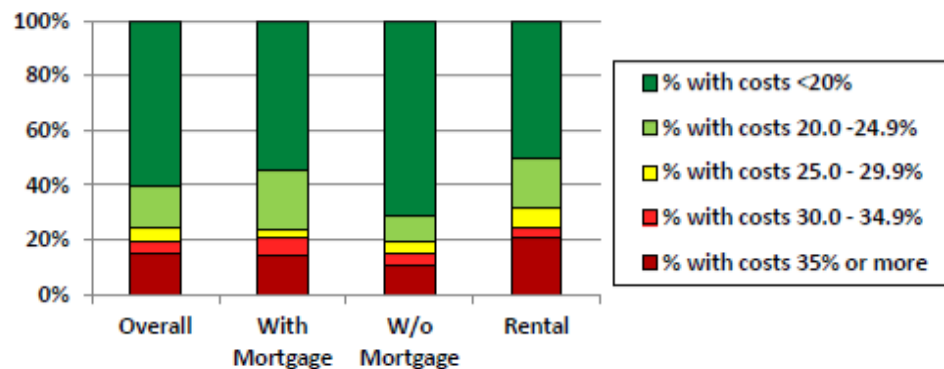


Figure C15: Number of Cost-Burdened Housing Units

