DEPARTMENT OF ENERGY;

Energy Efficiency and Renewable Energy

UNALAKLEET 14-PLEX ANALYSIS

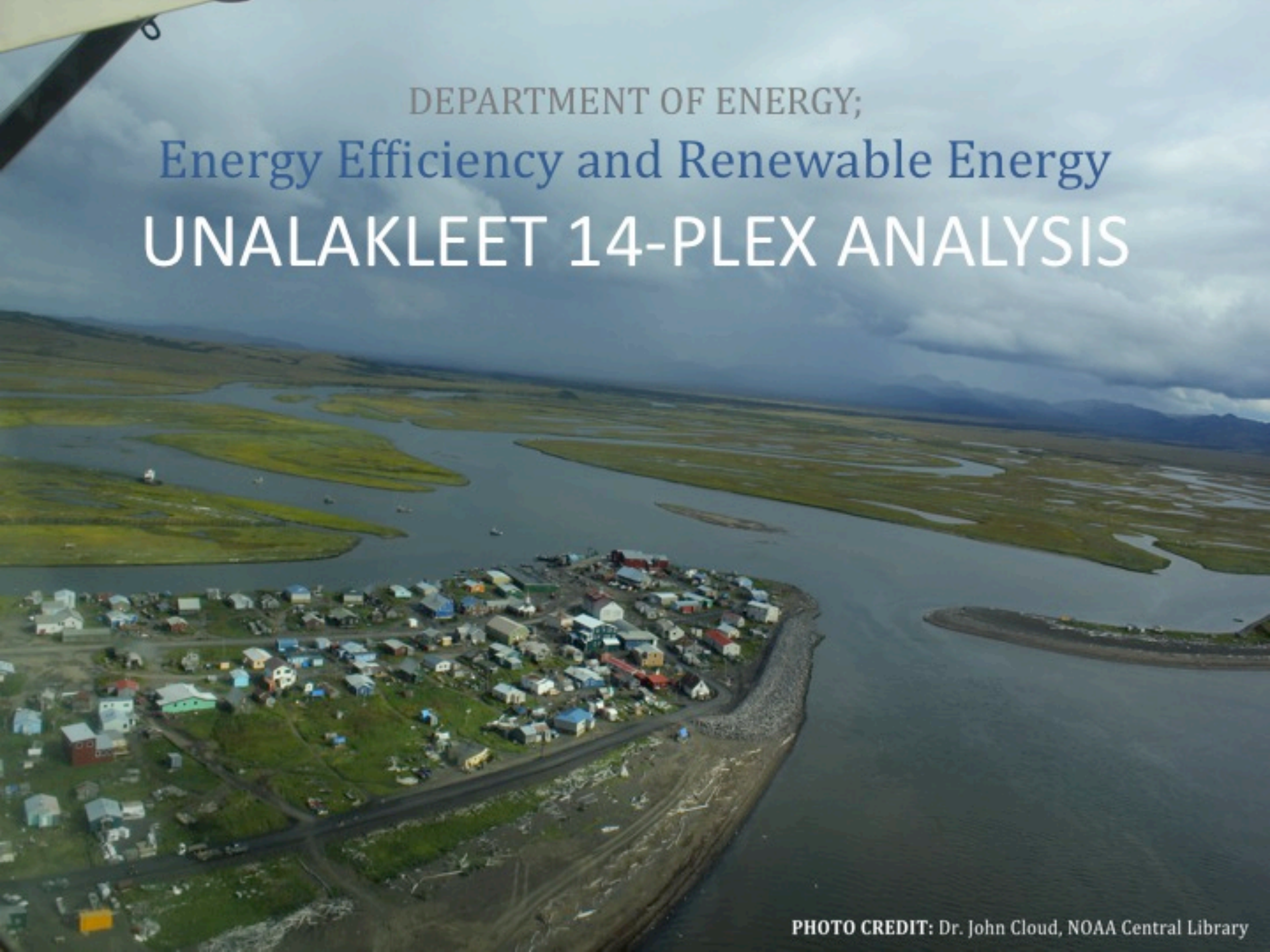


PHOTO CREDIT: Dr. John Cloud, NOAA Central Library


"Promoting and advancing the development of healthy, durable, and sustainable shelter for Alaskans and other Circumpolar people ."
RESEARCH | INNOVATION | EDUCATION
COLD CLIMATE HOUSING RESEARCH CENTER
CCHRC


Building Science Research
Product Testing
Policy Research
Sustainable Northern
Communities

The Challenges

32.5% of the housing stock is considered in need of major repair or **falling apart**

74.4 % of households are considered **drafty**

21.8% of households are unable to maintain 70° F on cold days in the winter

37.4% of households report having **mold/ mildew** in the home

Fuel oil prices reach as high as **$10/gallon**

55.9% of households have **income less than $20,000**

Housing units exhibiting the worst conditions are occupied by those with the lowest income.

DEPARTMENT OF ENERGY;

Energy Efficiency and Renewable Energy

UNALAKLEET 14-PLEX ANALYSIS

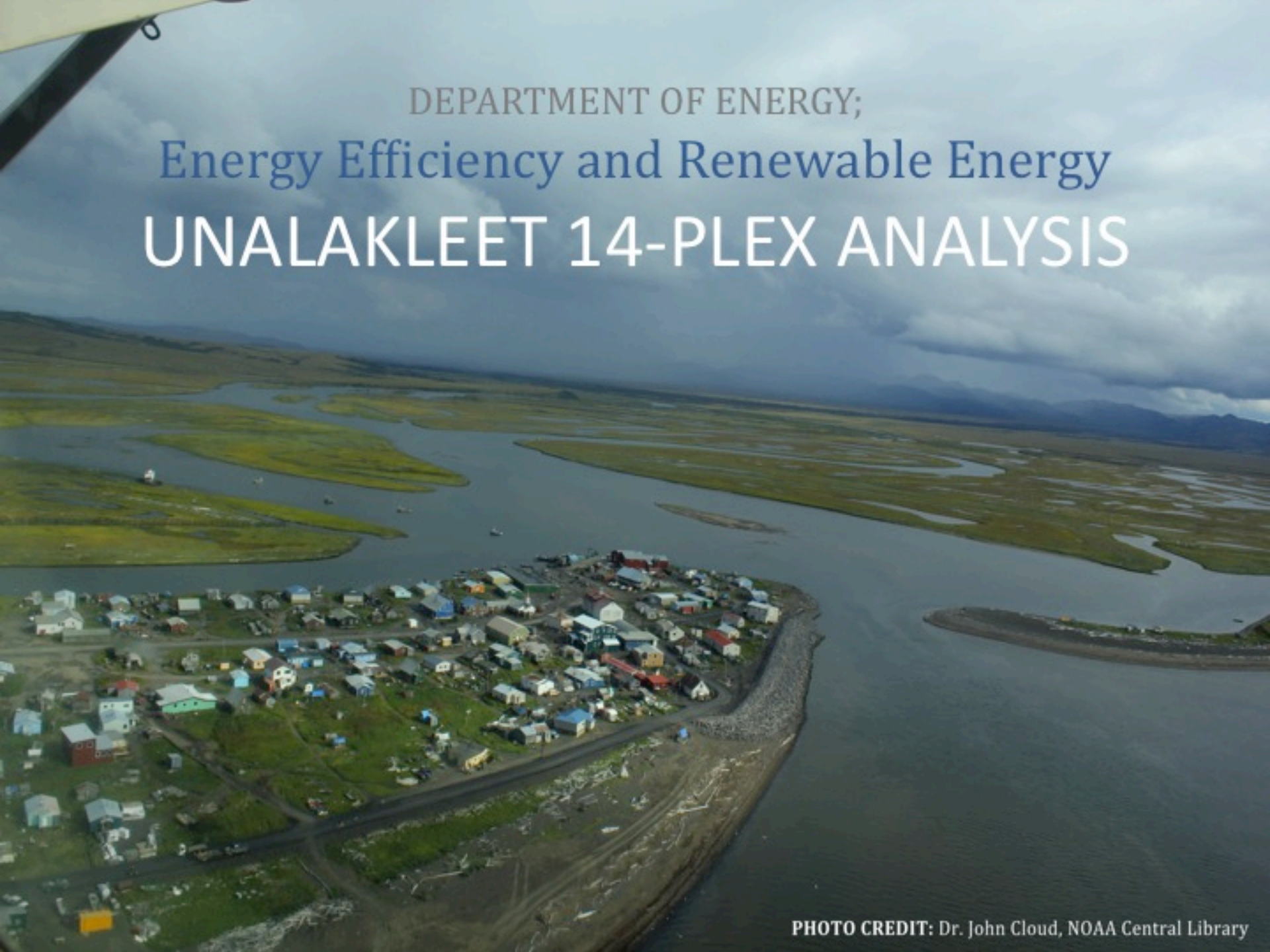


PHOTO CREDIT: Dr. John Cloud, NOAA Central Library

Feasibility Study: 14-PLEX

Assess and determine the technical and economic feasibility of energy efficiency improvements to the Native Village of Unalakleet's 14 apartment building to insure much needed low income housing

PHOTO CREDIT: Dr. John Cloud, NOAA Central Library


UNALAKLEET


Fort Collins
Loveland
Greeley
Longmont
Boulder
Denver
Centennial
Colorado
Colorado Springs
Pueblo
Durango

14-PLEX

Building Analysis TEAM

- Jack Hebert (**CCHRC**, President and Founder)
- Ilya Benesch (**CCHRC**, Carpenter, Building Science Specialist)
- Corey DiRutigliano (**CCHRC**, Project Manager/ Architectural Designer)
- Frank Thompson (**USKH**, Structural Engineer)
- Karl Hough (**Solutions for Health Breathing**, Energy Rater)
- Sheldon Katchatag (**Native Village of Unalakleet**, Housing Director)





Project Framework

- Building visit and investigation
- Steps Forward:
  - Possible futures
  - Increase efficiency
  - Set new precedents
  - Education/ workforce development

1970's

8 UNITS

1980's

+6 UNITS (14 total)


POLARIS


SYLVANIA
Cool White
40W

Structural

- All Weather Wood foundation on a concrete slab base

- Several noted conditions:
  - **No positive drainage** allowed pooling of surface water and saturation of soils
  - Minor **structural deflection** near the windows on the daylight-basement level

Testing/Modeling

- Blower Door
  - Method: calibrated depressurization of the building to measure heat loss due to air leakage

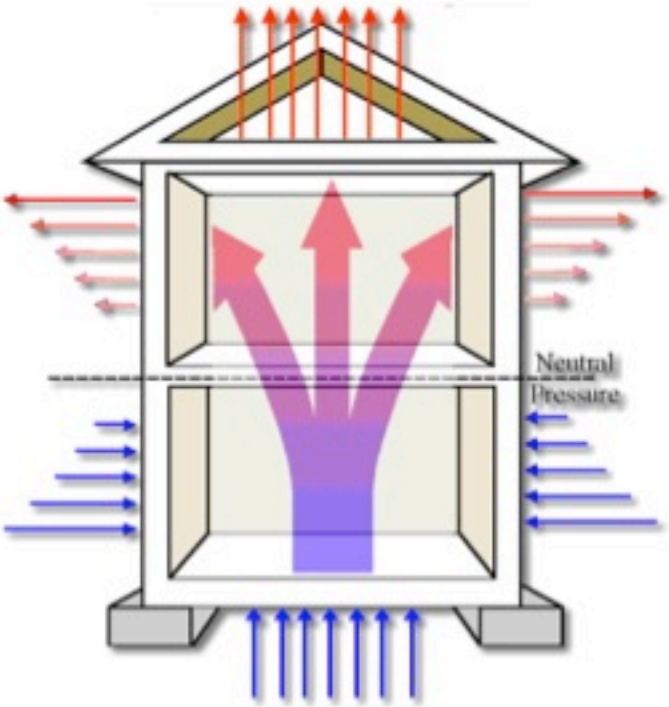
- Digital Model
  - For additional analysis and design

Indoor Air Quality

- Testing for a variety of potential hazards:
  - Radon Gas
  - Volatile Organic Compounds;
  - Carbon Monoxide
  - Mold

Occupant Comfort Levels

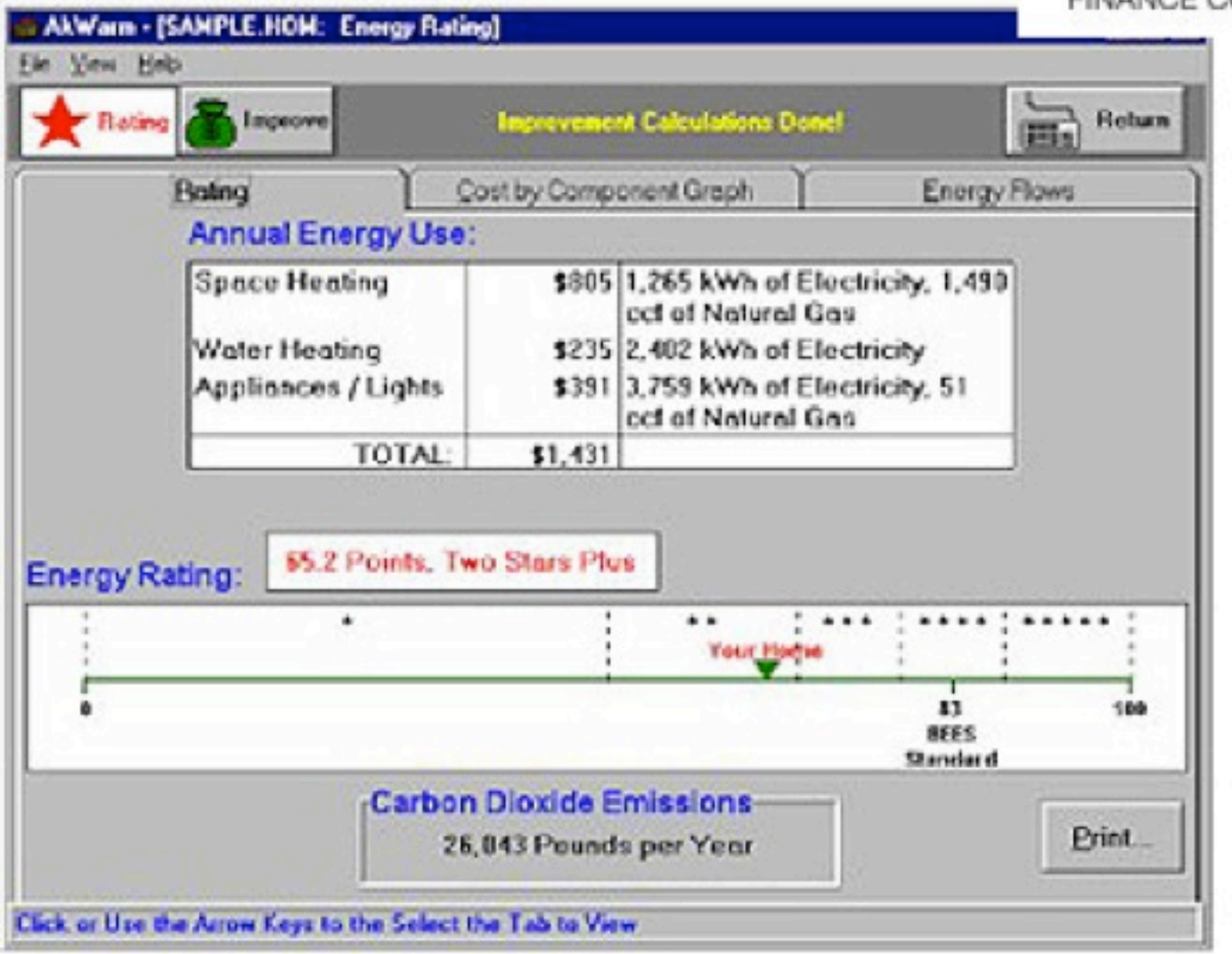
- Largest issues are:
  - Stack effect
  - heat stratification



http://www.kinetikenergysolutions.com/sites/default/files/ec_pro/kinetikenergysolutions/stack-effect.gif

AK WARM

Alaska Housing
FINANCE CORPORATION



EXISTING Building

EXISTING Building

ESTIMATED ANNUAL ENERGY USE:	*Current Building:*
Fuel use (gallons / year)	7,146
BTUs / year for fuel use	971,856,000
Electricity use (KWh / year):	59,541
BTUs / year for electricity use:	203,153,892
Total Combined BTUs / year:	1,175,009,892
ESTIMATED ANNUAL ENERGY COSTS ($ / year)	
Total Energy Costs:	$56,422
Space Heating:	$27,185
Water Heating:	$18,938
Ventilation Fans:	$0
Lighting:	$3,904
Refrigeration:	$3,163
Other Electrical	$1,867

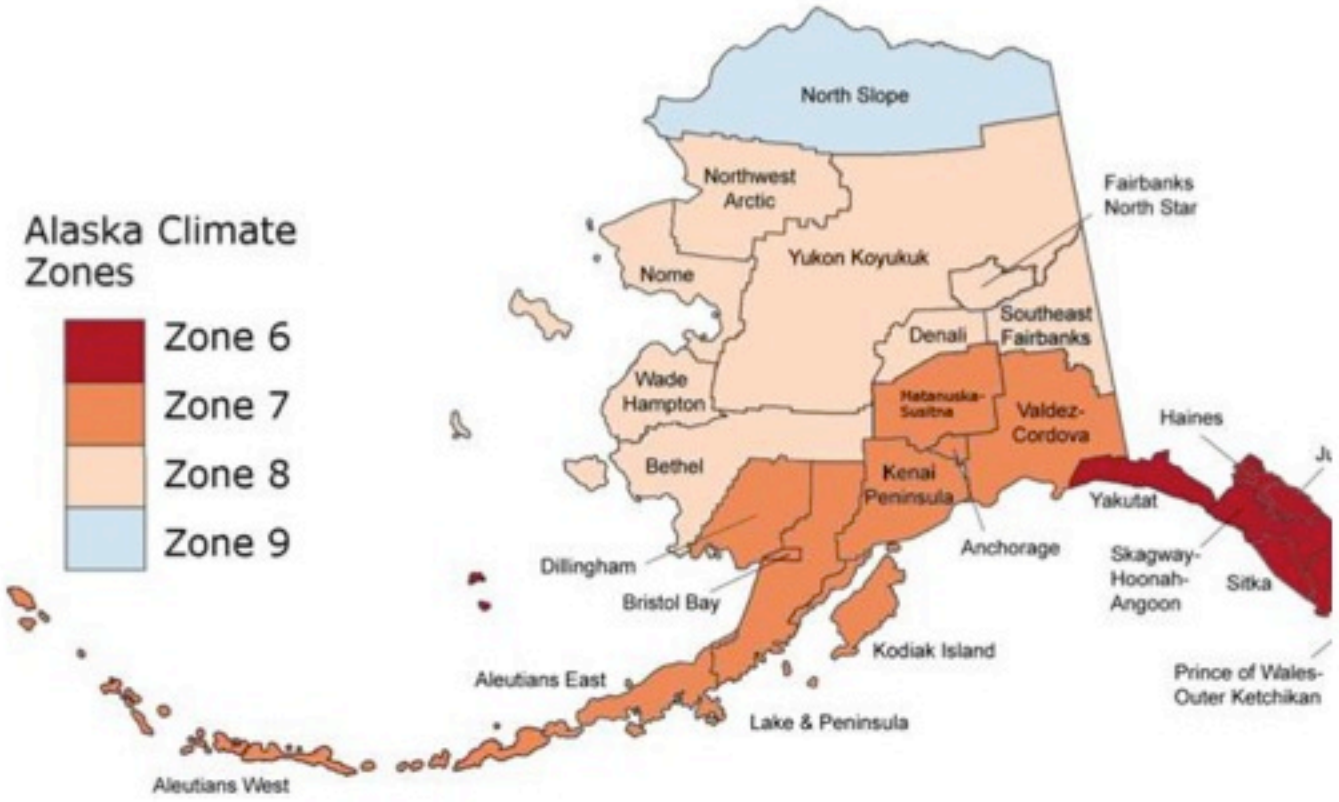
NOW WHAT?

NEW CONSTRUCTION Model

NEW CONSTRUCTION Model

2012 BEES Standard

International Energy Conservation Code (IECC)



Climate Zone	8 Group R	Al
Insulation entirely above deck	R-35ci	
Metal Buildings(with	R-30+	
R-5 thermal blocks) [a, b]	R-11LS	
Attic and other	R-49	
Mass	25ci	
Metal building	R-21+ R-10ci	
Metal framed	R-13+ R-16.7ci	R
Wood framed and other	R-13+ R-15.6ci	R
Below grade wall [c]	R-15ci	
Mass	R-18.8ci	R
Joist/framing [d]	R- 38/43	R
Unheated slabs	R-15 for 48" below	
Heated slabs [c]	R-20 for 48" below	
Swinging	U-0.37	
Roll-up or sliding	R-4.75	

NEW CONSTRUCTION Model

ESTIMATED ANNUAL ENERGY USE:	*New Construction, meeting BEES*
Fuel use (gallons / year)	6,097
BTUs / year for fuel use	829,192,000
Electricity use (KWh / year):	49,482
BTUs / year for electricity use:	168,832,584
Total Combined BTUs / year:	998,024,584
ESTIMATED ANNUAL ENERGY COSTS ($ / year)	
Total Energy Costs:	$47,544
Space Heating:	$20,500
Water Heating:	$18,706
Ventilation Fans:	$102
Lighting:	$3,686
Refrigeration:	$1,318
Other Electrical	$1,867

CCHRC RETROFIT Model

CCHRC RETROFIT Model

- **Reasons to RETROFIT:**
  - Building is structurally sound
  - Investment already in the ground
  - *Logistic costs* greatly *reduced*
  - Site/land issues have been resolved already
  - People can continue to inhabit their places while construction takes place

THINGS to RETROFIT:

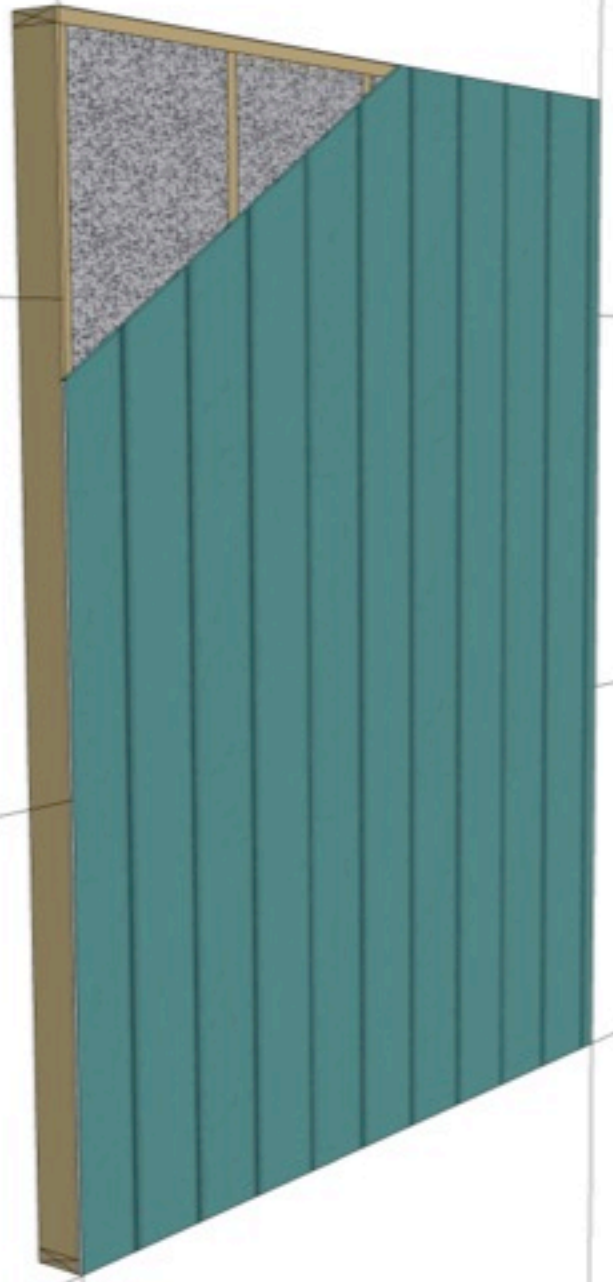
Envelope; walls, windows, roof

Mechanical; boilers, HRV, appliances

CCHRC RETROFIT Model

ESTIMATED ANNUAL ENERGY USE:	*CCHRC Retrofit:*
Fuel use (gallons / year)	4,476
BTUs / year for fuel use	608,736,000
Electricity use (KWh / year):	65,786
BTUs / year for electricity use:	224,461,832
Total Combined BTUs / year:	833,197,832
ESTIMATED ANNUAL ENERGY COSTS ($ / year)	
Total Energy Costs:	$40,449
Space Heating:	$10,881
Water Heating:	$18,160
Ventilation Fans:	$1,109
Lighting:	$3,904
Refrigeration:	$3,163
Other Electrical	$1,867

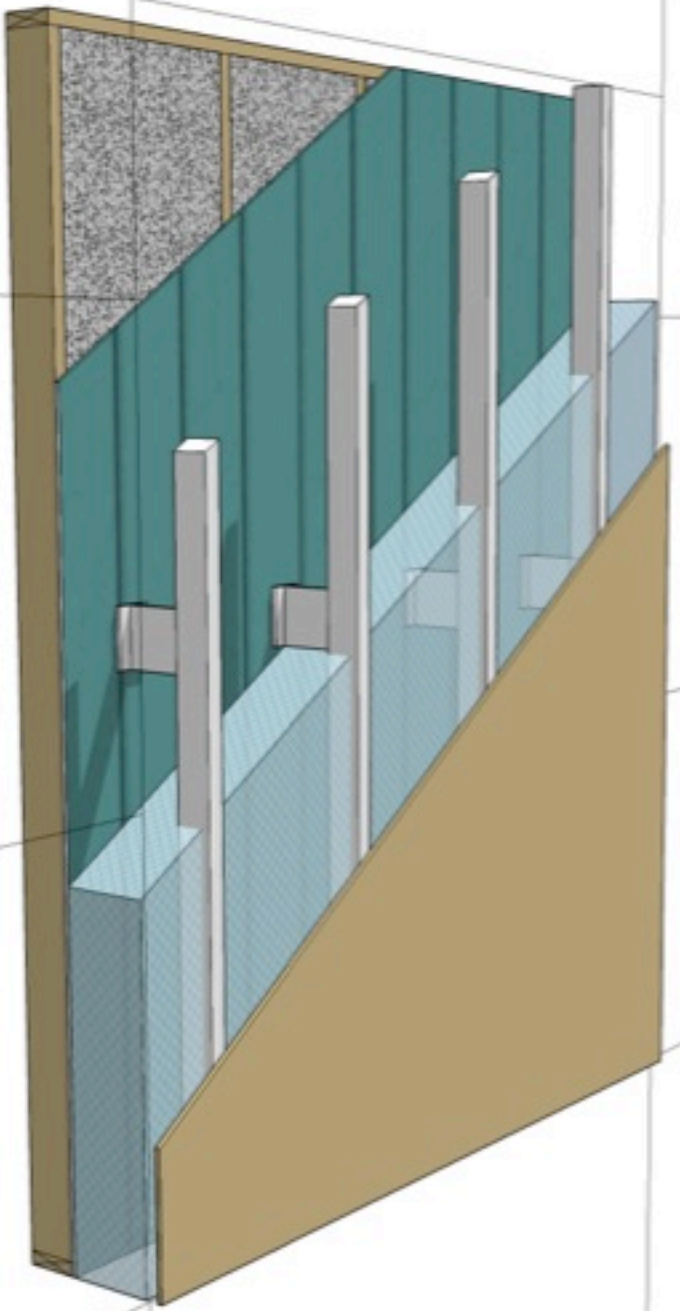
- EXISTING Wall
  - 2x6 Wood studs
  - Batt Insulation
  - T1-11 Cladding



- RETROFIT OPT #1
  - 2x6 Wood studs
  - Batt Insulation
  - T1-11 Cladding

+

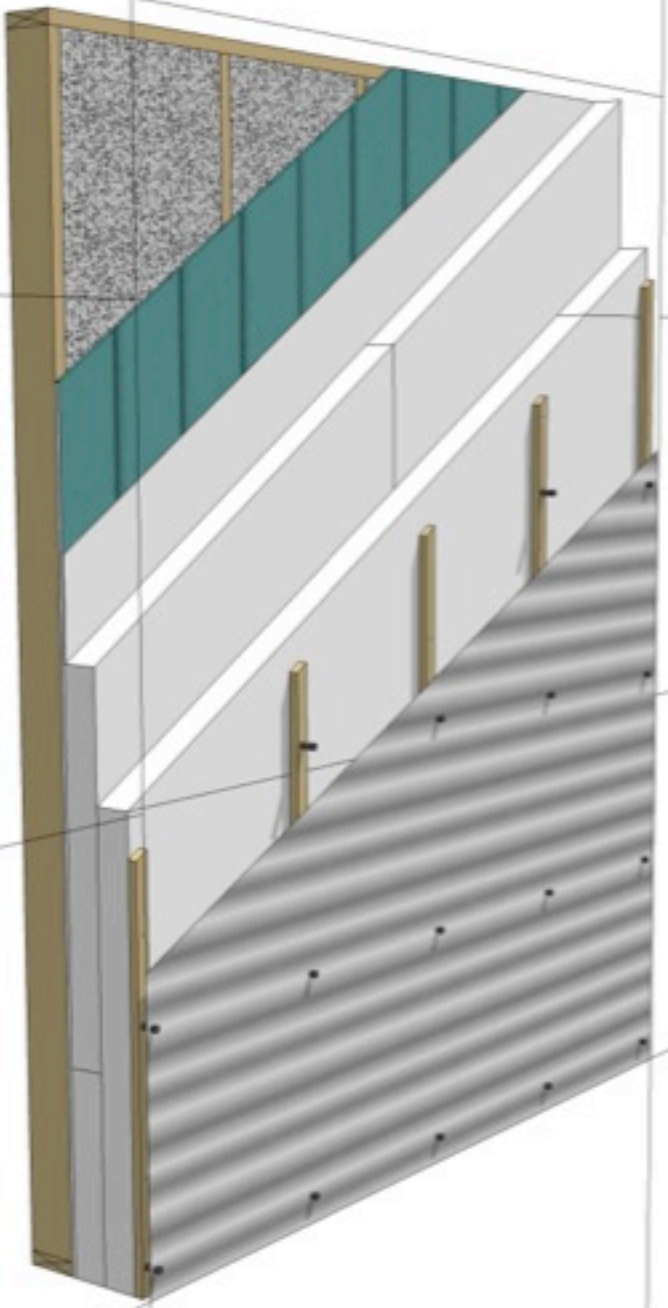
- Standoff wall
- Polyurethane Spray Foam
- Cladding



- RETROFIT OPT #2
  - 2x6 Wood studs
  - Batt Insulation
  - T1-11 Cladding

+

- REMOTE Wall
- Drain wrap (air barrier)
- Rigid XPS Foam
- Wood strapping
- Metal sheathing




WEST
NORTH
SOUTH
EAST

AT WHAT COSTS?

DO NOTHING

O&M costs continue to rise with gas prices
[Current gas usage at **7,146** gallons per year]

At ~ $6.50 per gallon it wont be long until the O&M costs more than rent can accommodate

What happens at $10 per gallon?

PRELIMINARY COST ESTIMATES

NEW CONSTRUCTION

US Department of Education costs per sq.ft. : + ~80% of Anchorage costs

New residential construction ranges from **$400 to $500 per square foot** in Nome
(150 miles from Unalakleet)

Cost range for reproducing a 14-Plex in Unalakleet today: $4 to 5.6 Million dollars

PRELIMINARY COST ESTIMATES

RETROFIT to EXISTING

Taking into consideration

Transportation of limited materials

Envelope – $300 – 400k

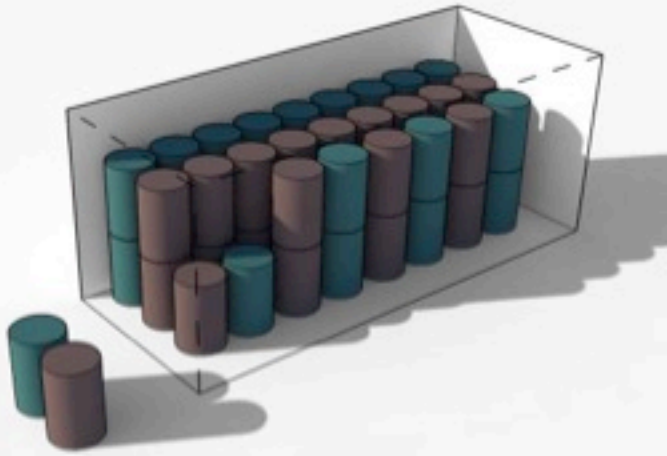
Mechanical –

Labor -

Logistic Implications

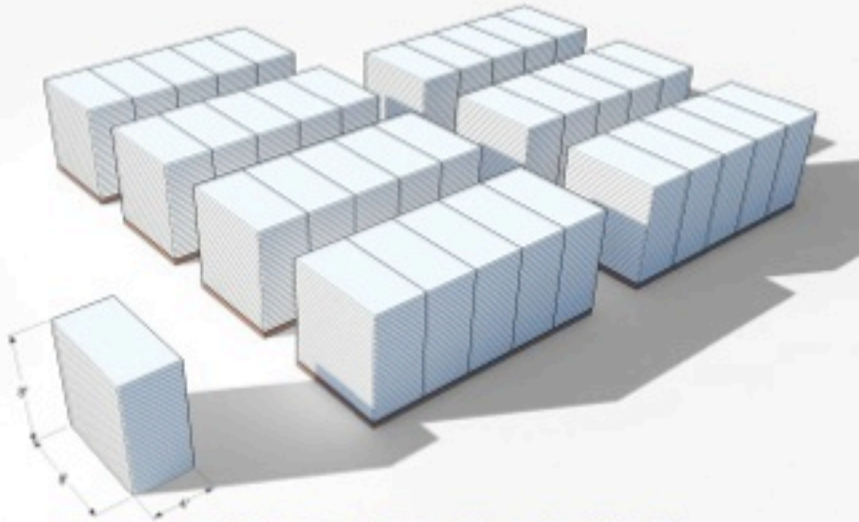
SPRAY FOAM (x)				
	Cost (per set)	**Number of Sets**		**Cost**
Material	$ 2,000.00	20	$	40,000.00
Labor-equip etc			$	70,000.00
		TOTAL	$	110,000.00
LOGISTICS (Barge)	**Number**	**Container Cost** (per)		**Cost**
20' SLC **Container**	1	$ 12,000.00	$	12,000.00
Fuel **Surcharge** (28%)			$	3,360.00
		TOTAL COST		**$ 125,360.00**

RIGID FOAM (Insulfoam)				
	Price (sq.ft.)	**Area** (sq.ft.)		**Cost**
WALLS: 8" Thick	$ 3.20	6,000	$	19,200.00
ROOF: 12" Thick	$ 4.80	4,800	$	23,040.00
		TOTAL	$	42,240.00
LOGISTICS (Barge)	**Number**	**Container Cost** (per)		**Cost**
20' SLC **Platform**	7	$ 14,000.00	$	98,000.00
Fuel **Surcharge** (28%)			$	27,440.00
		TOTAL COST		**$ 167,680.00**



SPRAY FOAM

25 SETS



RIGID FOAM

7 Platforms

ENERGY COMPARISONS

EXISTING vs. NEW CONSTRUCTION

Current Unalakleet 14 plex vs. New Construction				
ESTIMATED ANNUAL ENERGY USE:	*Current Building:*	*New Construction, meeting BEES*	**AMOUNT SAVED:**	**PERCENT CHANGE**
Fuel use (gallons / year)	7,146	6,097	-1,049	-15%
BTUs / year for fuel use	971,856,000	829,192,000	-142,664,000	-15%
Electricity use (KWh / year):	59,541	49,482	-10,059	-17%
BTUs / year for electricity use:	203,153,892	168,832,584	-34,321,308	-17%
Total Combined BTUs / year:	1,175,009,892	998,024,584	-176,985,308	-15%
ESTIMATED ANNUAL ENERGY COSTS ($ / year)				
Total Energy Costs:	$56,422	$47,544	$8,878	16%
Space Heating:	$27,185	$20,500	$6,685	25%
Water Heating:	$18,938	$18,706	$232	1%
Ventilation Fans:	$0	$102	($102)	
Lighting:	$3,904	$3,686	$218	6%
Refrigeration:	$3,163	$1,318	$1,845	58%
Other Electrical	$1,867	$1,867	$0	0%

TOTAL ANNUAL ENERGY COST REDUCTION OF **16%**

(~$9,000 savings per year)

ENERGY COMPARISONS

EXISTING vs. RETROFIT

Current Unalakleet 14 plex vs. CCHRC Retrofit				
ESTIMATED ANNUAL ENERGY USE:	***Current Building:***	CCHRC Retrofit:	**AMOUNT SAVED:**	**PERCENT CHANGE**
Fuel use (gallons / year)	7,146	4,476	-2,670	-37%
BTUs / year for fuel use	971,856,000	608,736,000	-363,120,000	-37%
Electricity use (KWh / year):	59,541	65,786	6,245	10%
BTUs / year for electricity use:	203,153,892	224,461,832	21,307,940	10%
Total Combined BTUs / year:	1,175,009,892	833,197,832	-341,812,060	-29%
ESTIMATED ANNUAL ENERGY COSTS ($ / year)				
Total Energy Costs:	$56,422	$40,449	$15,973	28%
Space Heating:	$27,185	$10,881	$16,304	60%
Water Heating:	$18,938	$18,160	$778	4%
Ventilation Fans:	$0	$1,109	($1,109)	
Lighting:	$3,904	$3,904	$0	0%
Refrigeration:	$3,163	$3,163	$0	0%
Other Electrical	$1,867	$1,867	$0	0%

TOTAL ANNUAL ENERGY COST REDUCTION OF **28%**

(~$16,000 savings per year)

ENERGY COMPARISONS

NEW CONSTRUCTION vs. *RETROFIT*

New Construction vs. CCHRC Retrofit				
ESTIMATED ANNUAL ENERGY USE:	*New Construction, meeting BEES*	CCHRC Retrofit:	**AMOUNT SAVED:**	**PERCENT CHANGE**
Fuel use (gallons / year)	6,097	4,476	-1,621	-27%
BTUs / year for fuel use	829,192,000	608,736,000	-220,456,000	-27%
Electricity use (KWh / year):	49,482	65,786	16,304	33%
BTUs / year for electricity use:	168,832,584	224,461,832	55,629,248	33%
Total Combined BTUs / year:	998,024,584	833,197,832	-164,826,752	-17%
ESTIMATED ANNUAL ENERGY COSTS ($ / year)				
Total Energy Costs:	$47,544	$40,449	$7,095	15%
Space Heating:	$20,500	$10,881	$9,619	47%
Water Heating:	$18,706	$18,160	$546	3%
Ventilation Fans:	$102	$1,109	($1,007)	
Lighting:	$3,686	$3,904	($218)	-6%
Refrigeration:	$1,318	$3,163	($1,845)	-140%
Other Electrical	$1,867	$1,867	$0	0%

Bottom line: *Spend significantly less money and end up with a building that is more efficient.*

Project Follow through

- Fine tune the retrofit plan
  - Water, renewable energy?
- Construct detailed budget projections for retrofit
- Outline the education opportunities
- Finalize report
- [potentially] Assist village in seeking out additional funding to make project a reality


Unalakleet 14-Plex; the devil you know

THANK YOU

Corey DiRutigliano

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