

*“Promoting and advancing the development of healthy, durable, and sustainable shelter for Alaskans and other Circumpolar People”*



COLD CLIMATE HOUSING RESEARCH CENTER

**CCHRC**



# CCHRC Research and Testing Facility



LEED Platinum



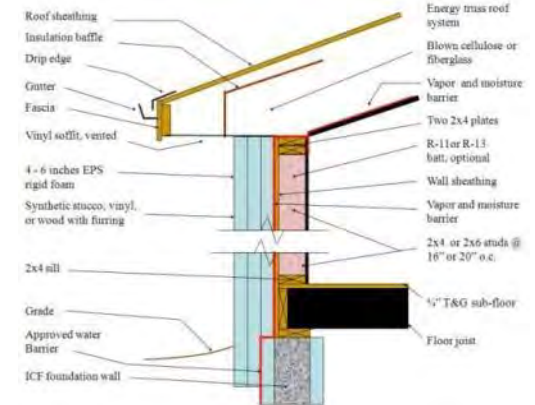
# SIEMENS

Runner-up  
Smartest Building in America



# Research Programs

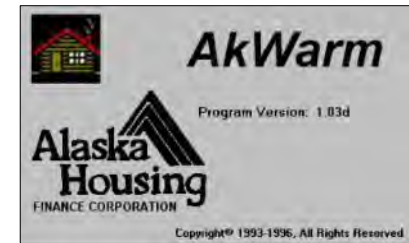
## Building Envelopes & Materials



## Energy & Mechanical Systems



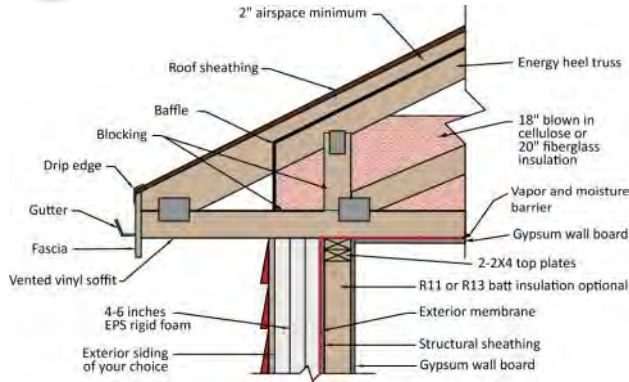
## Policy & Program Development





# Building Envelopes and Materials

Leader in “Green Building Standards”  
Advancing Building Science  
Multiple Federal Partners





# Net Zero- Passive House



Alaska is part of the  
Global Arctic Community



# Indigenous Wisdom for our dilemma in time

## FIRST NEEDS



Archives, University of Alaska, Fairbanks

- Water
- Food
- Shelter



# Indigenous Wisdom for our dilemma in time

## RESPONSIBILITY

- Sustainability
- Respect
- Community





# Indigenous Wisdom for our dilemma in time

10,000 years of success should guide the process

Aleutian Islands



Anaktuvuk Pass



Point Hope



Barrow





# Indigenous Wisdom for our dilemma in time

## LEARN FROM NATURE

RETAINING heat, not PRODUCING heat, is the most important part of an animal's survival.





# The Need

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 20° C on cold days in the winter.

37.4% of households reported having mold or mildew in the home.

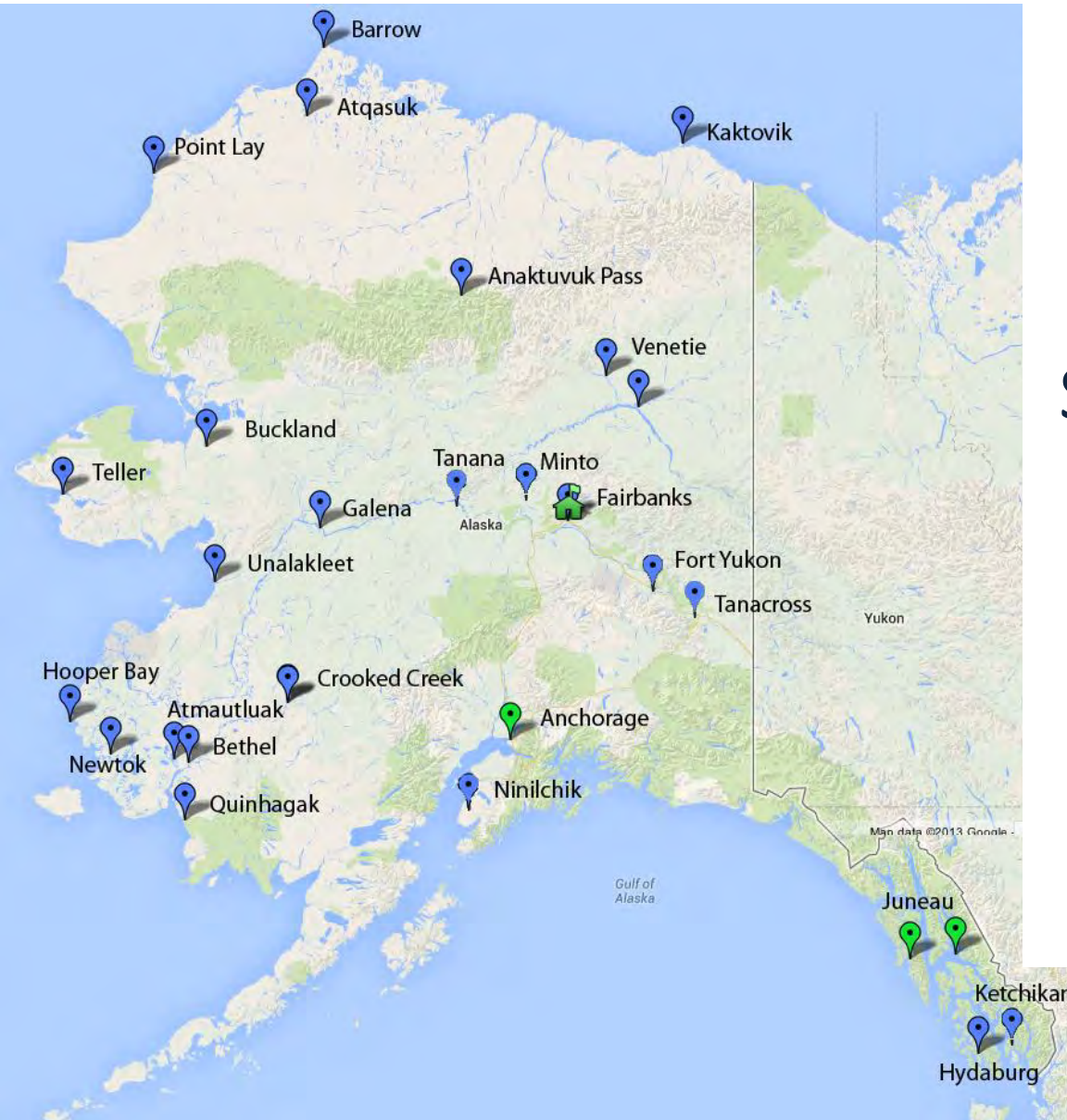
Fuel oil prices reach as high as \$2.50/liter.

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

Arctic is changing, 184 Alaskan communities threatened by erosion

Natural disasters are becoming more frequent





# Sustainable Northern Communities

## Building Alaska's Future Together



# Sustainable Northern Communities

## INNOVATIVE COLABORATIVE HOUSING DESIGN

Anaktuvuk Pass Prototype



Average house: 5,400 liters/yr  
Prototype house: 500 liters/yr

Atmautluak Prototype



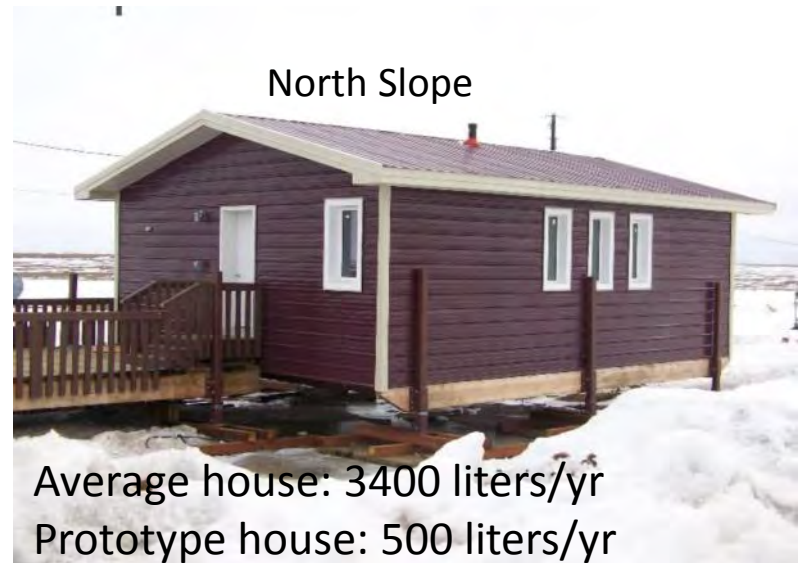
Average house: 3600 liters/yr  
Prototype house: 450 liters/yr

Quinhagak Prototype



Average house: 3800 liters/yr  
Prototype house: 600 liters /yr

North Slope



Average house: 3400 liters/yr  
Prototype house: 500 liters/yr



# Indigenous wisdom



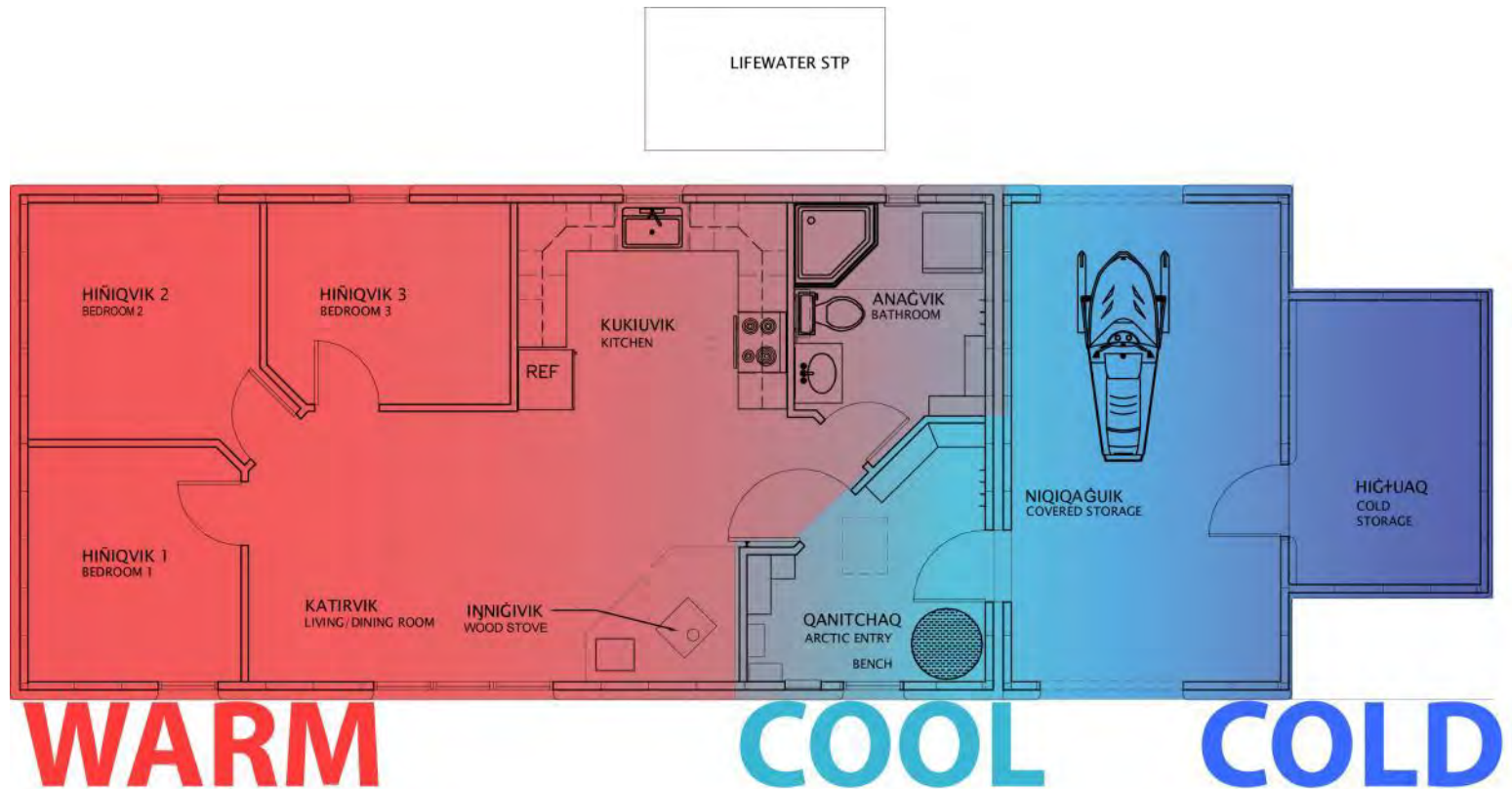


# 21<sup>st</sup> century technology



# Design

## *SNS Prototype Floor Plan*





# Energy and Cost Efficient



Earth berming



Sod



Waste water treatment



Heating and ventilation



Lighting



Alternative energy



# Sustainable Northern Communities

*"We need housing. Our young people have no place to live."*

George Paneak (1950-2009) Former Mayor of Anaktuvuk Pass

## Design Challenges

- 16,000 HDD
- Electricity \$.60/kWh
- Heating Oil \$8/gallon
- 5000 liters/yr.
- New house is \$750,000
- Last house built ten years ago
- Context appropriate housing
- Transportation costs

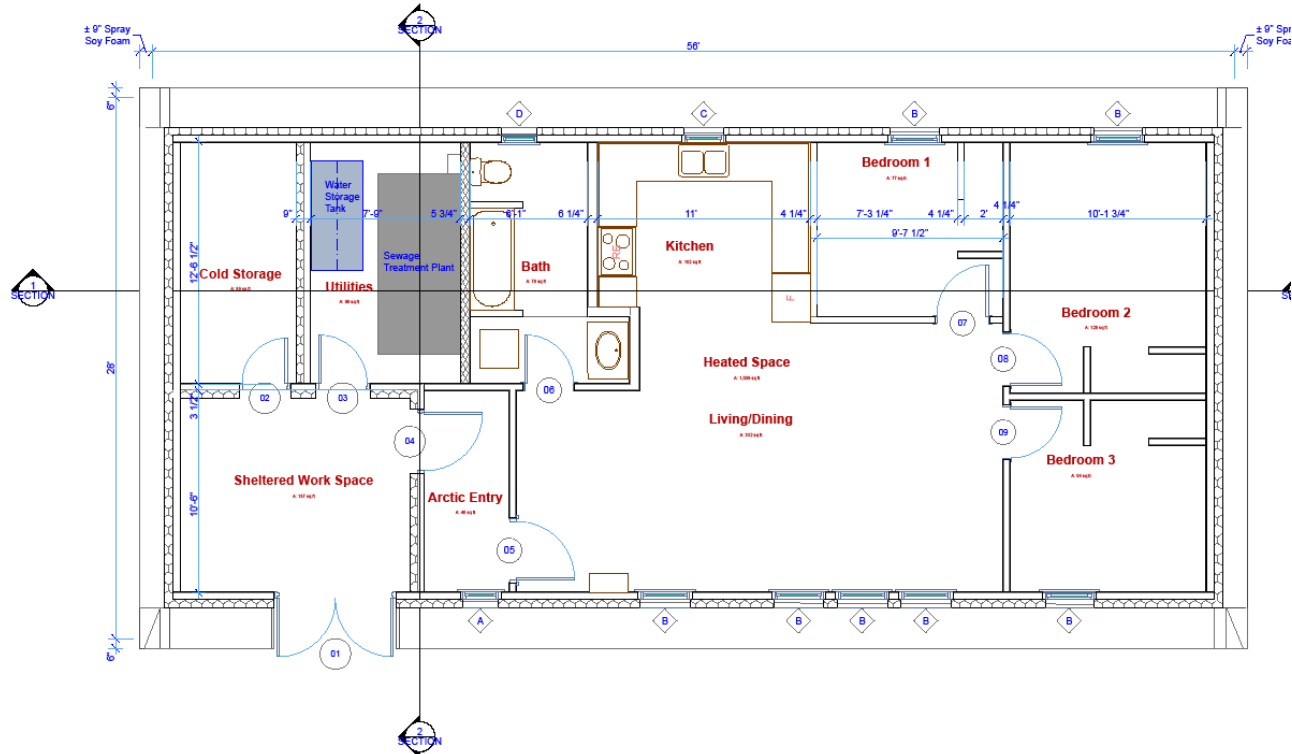
## Construction Outcomes

- Cost significantly less than new home quotes
- 500 liters fuel annually
- Completed in four weeks
- Local work force
- Approaches net 0





# Tagiugmiullu Nunamiullu Design Charettes





## *Tagiugmiullu Nunamiullu Housing Authority*



- Walls: Steel studs with plastic offsets
- R-60 spray foam insulation
- Metal siding

- Insulated thermal raft foundation
- All utilities incorporated
- Light, energy efficient, lower cost





# *Tagiugmiullu Nunamiullu Housing Authority*





# Quinhagak

## Design Charette (share it)





# Building Envelope Thermal Raft Foundation



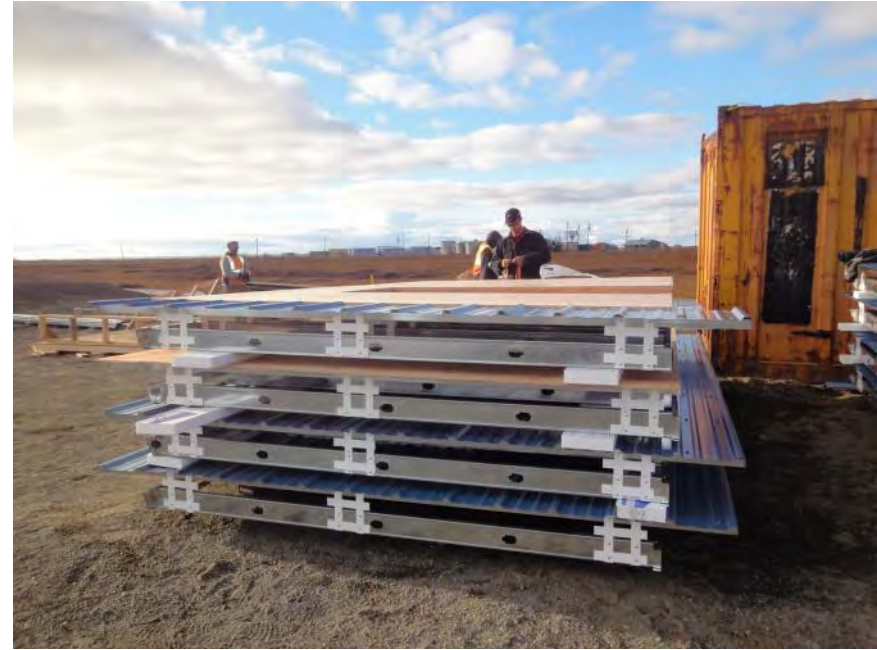
# Quinhagak



# Constructability



# Instruction & Local Labor





# Quinhagak House Construction





# Quinhagak House - Performance

- 500 liters fuel oil first winter
- Superior indoor air
- Built in 6 weeks
- Local labor force
- Light materials
- High owner comfort
- Significantly less cost
- Durable





## Prototype to Production





Quinhagak House  
becomes the people's





Quinhagak  
House  
becomes the  
people's



450 liters oil annually  
Warm, healthy, affordable



# Crooked Creek- SNS Immediately

Flooding in May 2010



Photo by John Madden





# Crooked Creek

It takes a Village  
To rebuild a village





# Crooked Creek

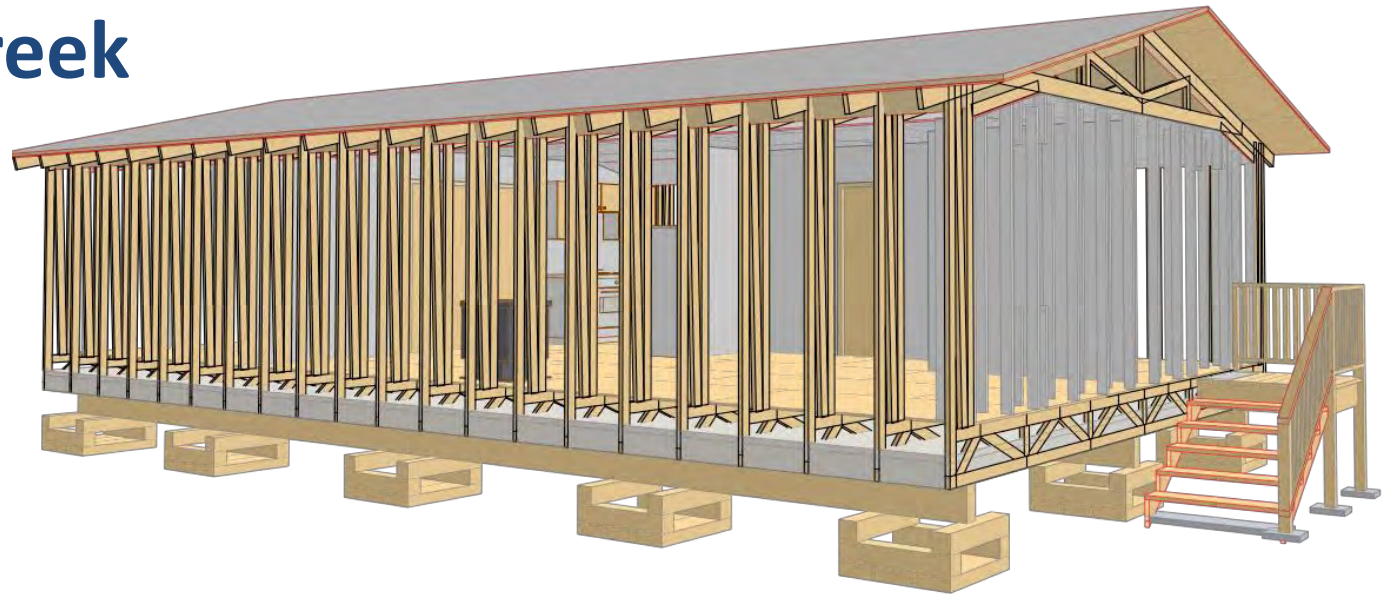
## The Challenge

- TIME – need 9 replacement homes by winter
- Building above floodplain
- Design must be easy to ship, quick to build
- Single modular design for small cabin and 4-BR house
- Very low cost

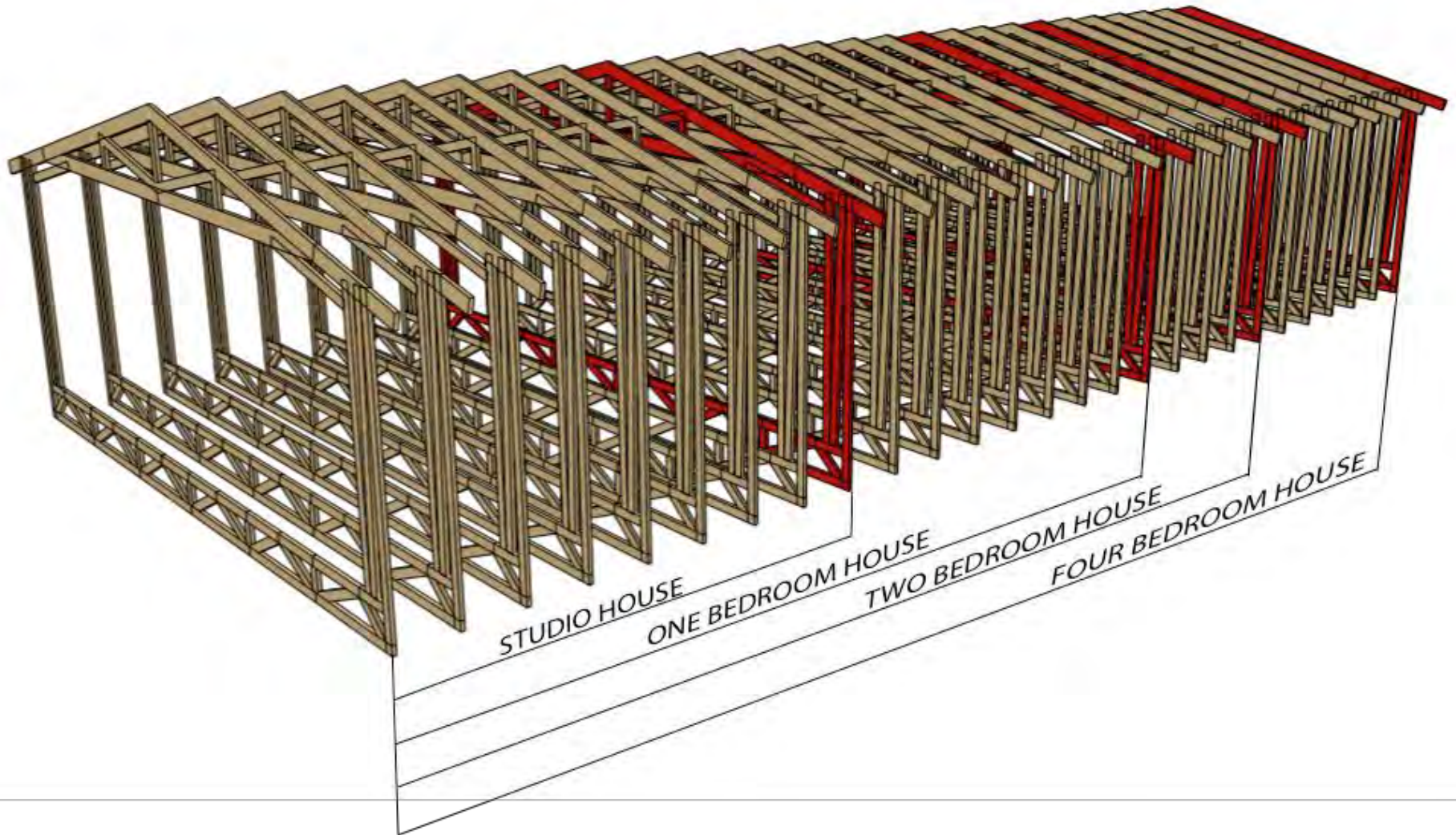




# Crooked Creek

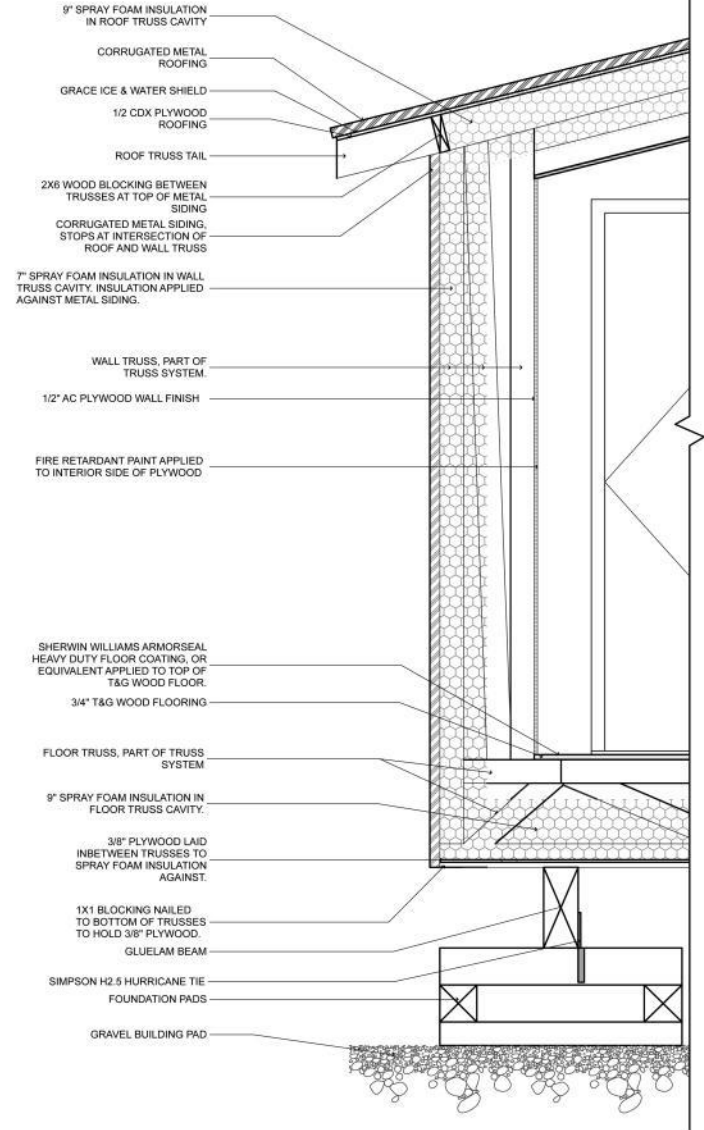


- Partner Co-ordination
- Materials arriving
- Volunteers Building
- Knowledge being shared
- Finished by Oct. 1
- Follow-up for future





# Crooked Creek



2 TRUSS WALL SECTION

SCALE: 1" = 1'-0"





# Crooked Creek

Quick Assembly  
No thermal bridge  
Structural



Tight assembly must be ventilated  
Annual fuel usage very low



# Crooked Creek

An old life in a new home





# Kusilvak Census Area, Alaska

Average house:

\$12,000 annual energy cost

3 Star (new), 1 Star (1960s era)

51% houses overcrowded

250 cost-burdened households

Up to 30% housing in structural failure

Highest rates of upper respiratory distress in the  
North America

# Atmautluak



# Atmautluak

Atmautluak design





# BETHEL TRUSS PLANT

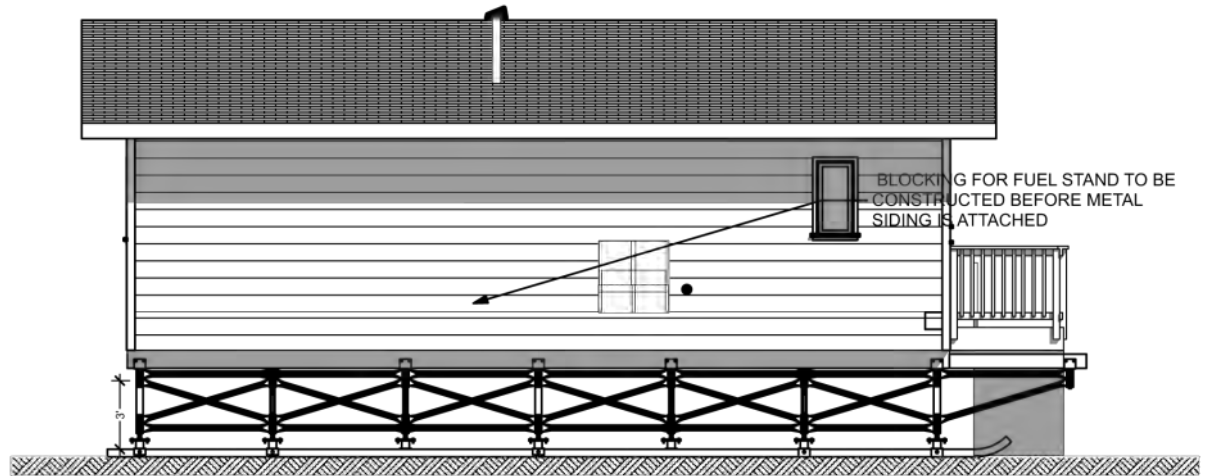
AVCP in partnership with CCHRC  
Bethel, Alaska - November 2015

# Newtok



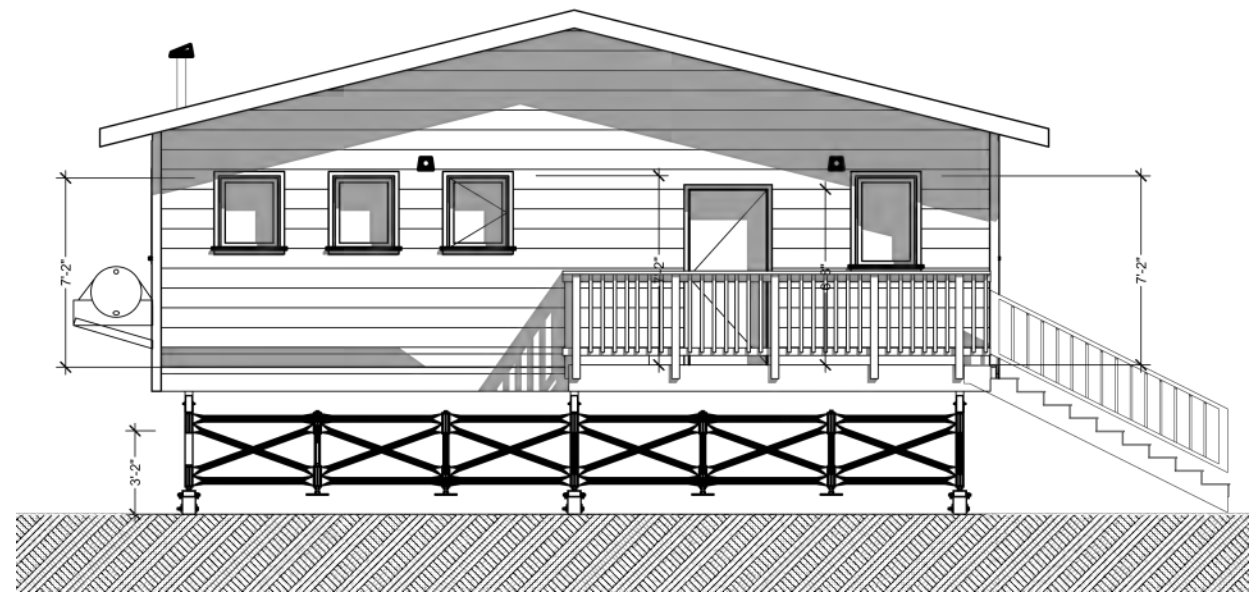
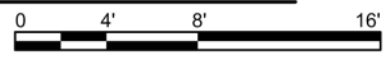
# Newtok





②

WEST ELEVATION





# Newtok/ Merktarvik







# PASS- Portable Alternative Sanitation System

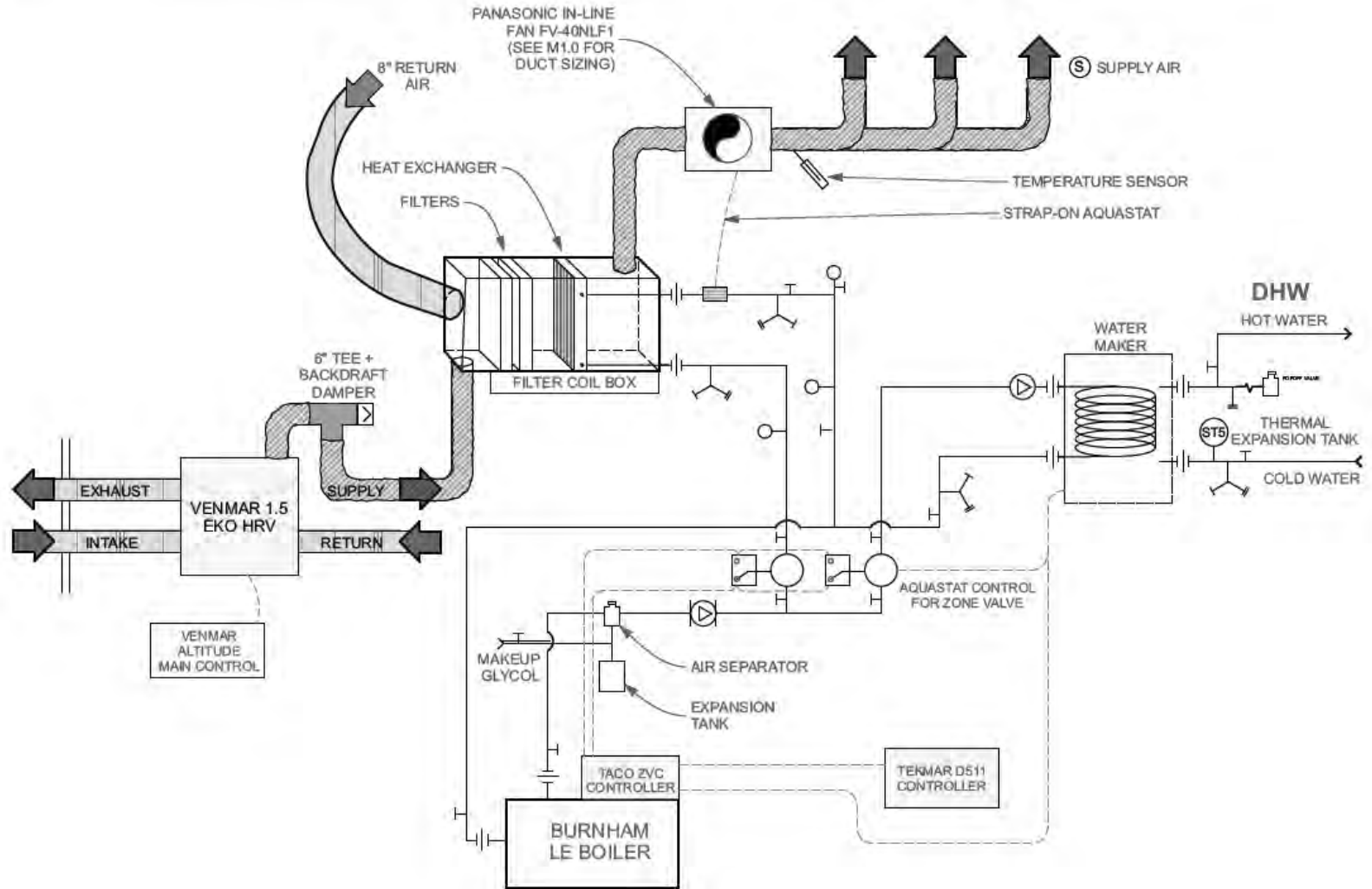


## KEY

- |                           |   |
|---------------------------|---|
| A) RAIN WATER CATCHMENT   | F) GREY WATER TANK - PURGES TO OUTDOORS WHEN FULL |
| B) INTEGRATED VENTILATION | G) WATERLESS URINAL                               |
| C) GRAVITY FEED SUPPLY    | H) WATER TREATMENT PLANT                          |
| D) SEPARATING TOILET      |   |
| E) LOW-FLOW SINK          |   |



## BRHEATHE SYSTEM SCHEMATIC





# BrHEAThe- Warm and healthy air





# Newtok/ Merktarvik





# VENETIE

4800 square foot 4 plex – 1200 liters

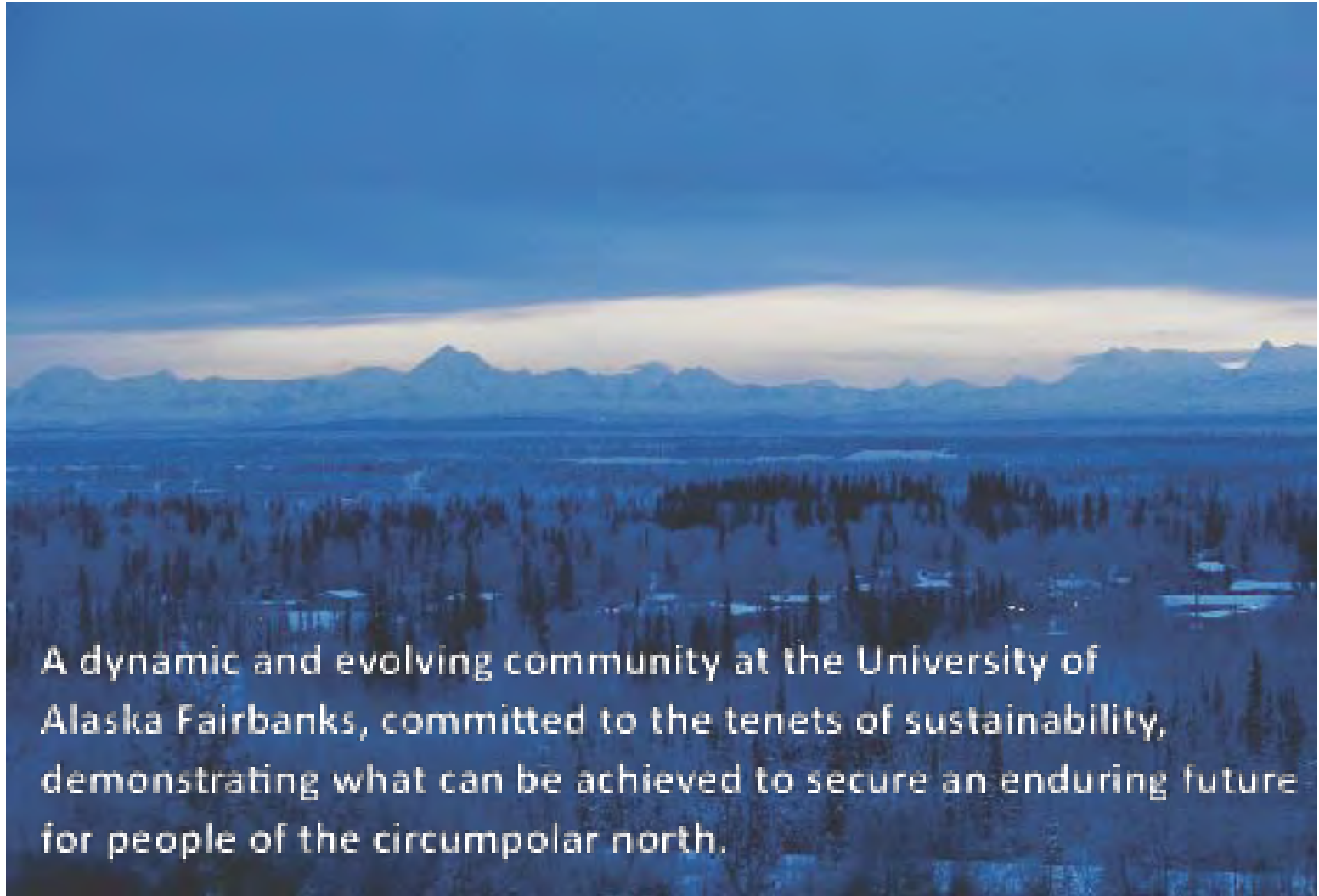




So many challenges  
we face together



# The University of Alaska's Sustainable Village



# The UAF Sustainable Village



**A RESEARCH PROJECT IN SUSTAINABLE LIVING**

# The UAF Sustainable Village

2011

- Student Design Competition
- Site development
- Design first low cost net-zero-energy homes
- Students as live-in researchers
- Community design



# UAF Sustainable Village



**warmth + shade** thermal shutters rated to R-10 prevent heat loss at night in the winter. In the summer, they fold up to create awnings and shade from unwanted solar gain.

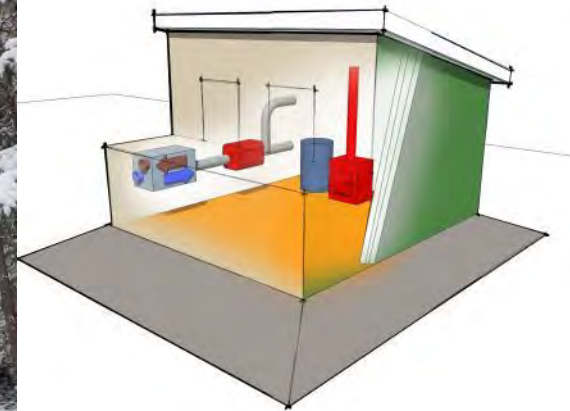
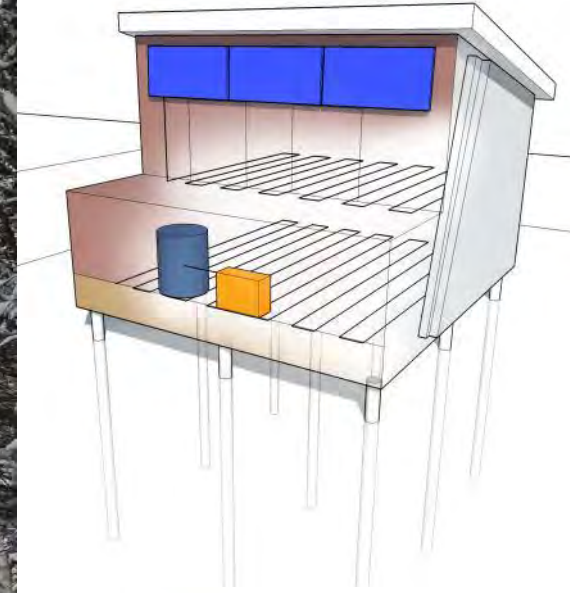
**garden** rooftop or ground level gardens provide personal plots for each resident and a relaxing place to read or study in the summer months. The balcony garden cantilevers over the lower level for sun shading.



# UAF Sustainable Village



4 PROTOTYPES

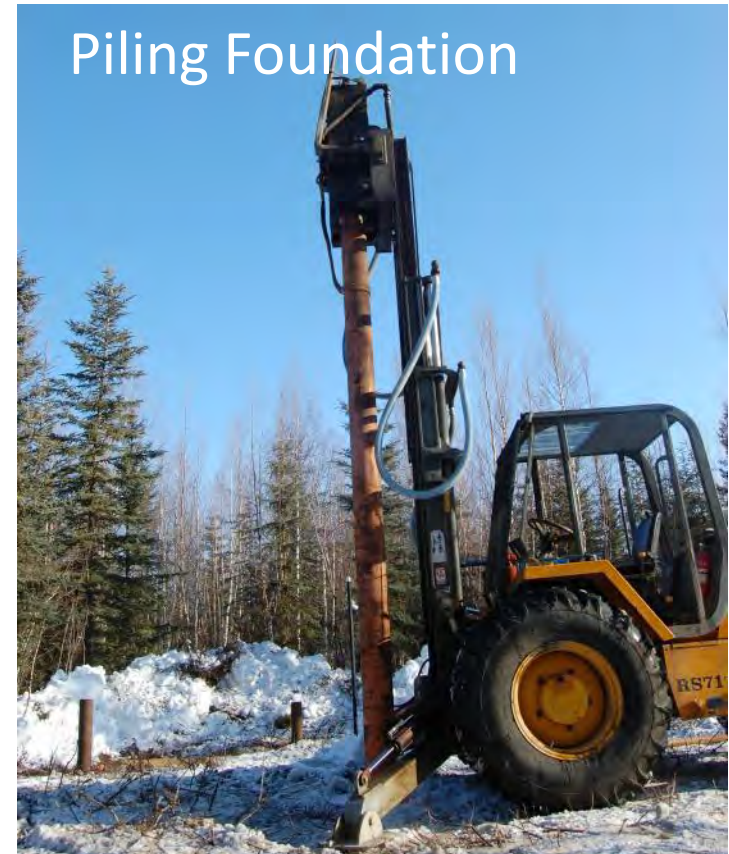


## 2 Foundation Types

Foam Raft (\$10,000 savings)

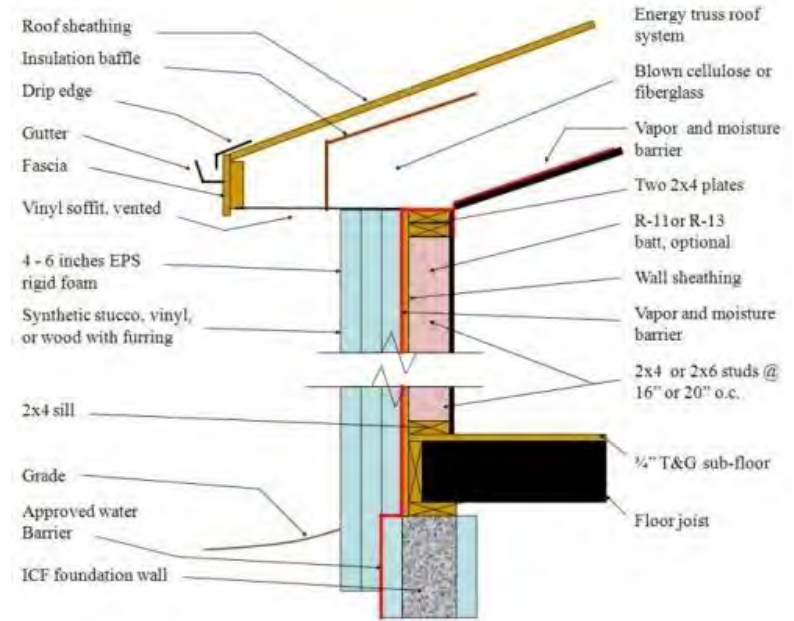


Piling Foundation



# 2 Wall Assemblies (R-50)

REMOTE System  
with EPS



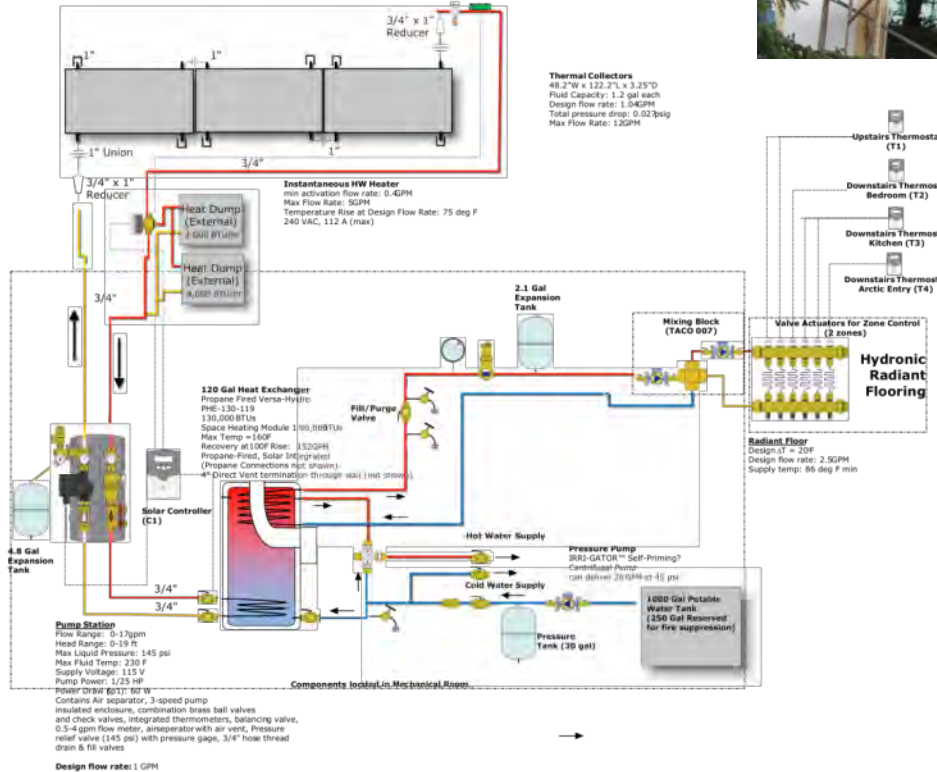
# Arctic Wall system with cellulose



# Sustainable Village “Willow House”



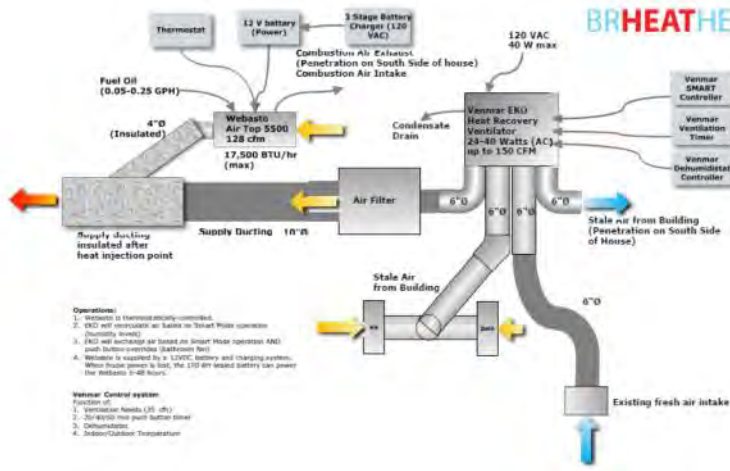
# Solar Hydronic Heating





## Sustainable Village “Spruce House”

# Highly efficient integrated heating/ ventilation/ power



# On Site water and wastewater



# Homes in an Urban Forest



# The “Living Building Challenge”

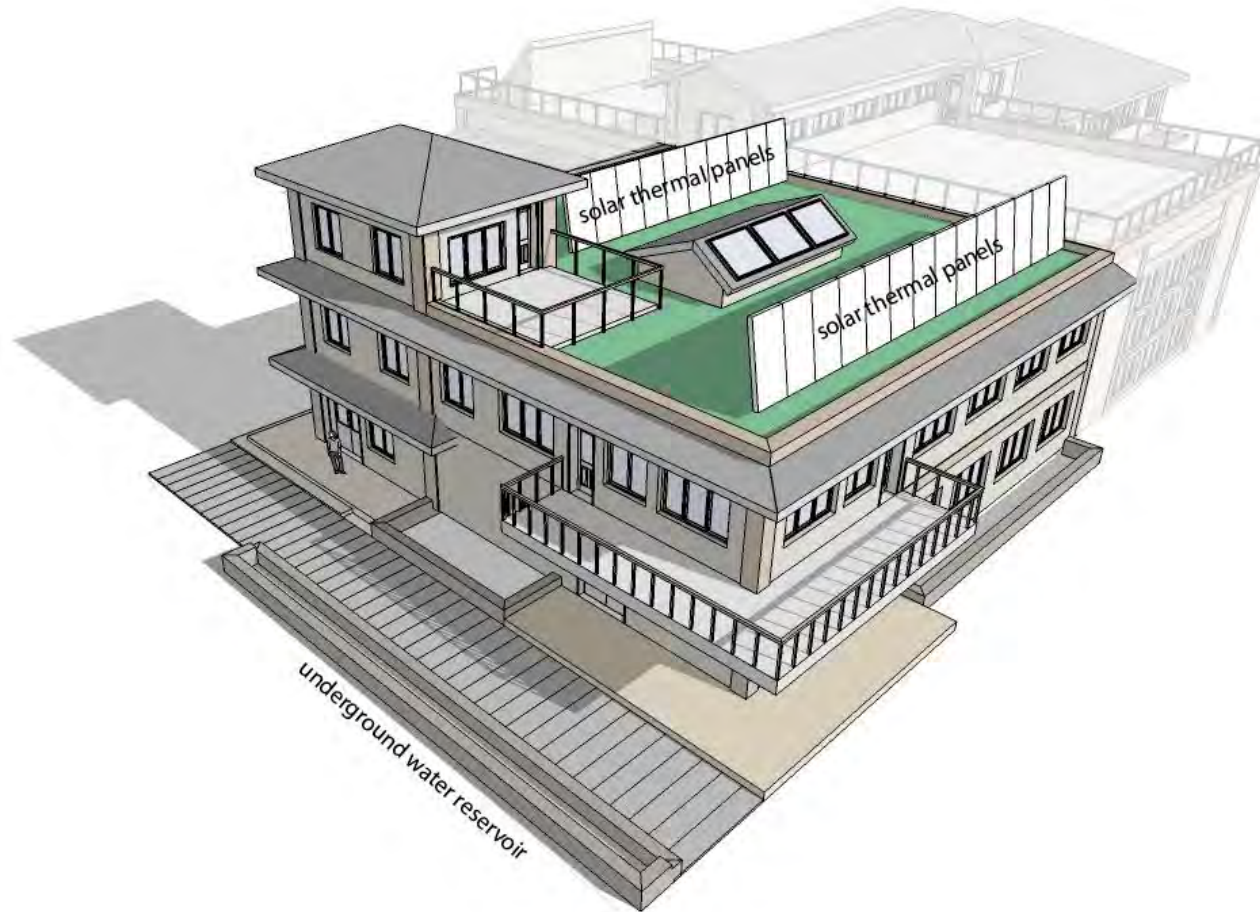
SUSTAINABLE NORTHERN COMMUNITIES



Working together with all our partners

# The “Living Building Challenge”

SUS



Working together with all our partners



# Approaching Net-Zero

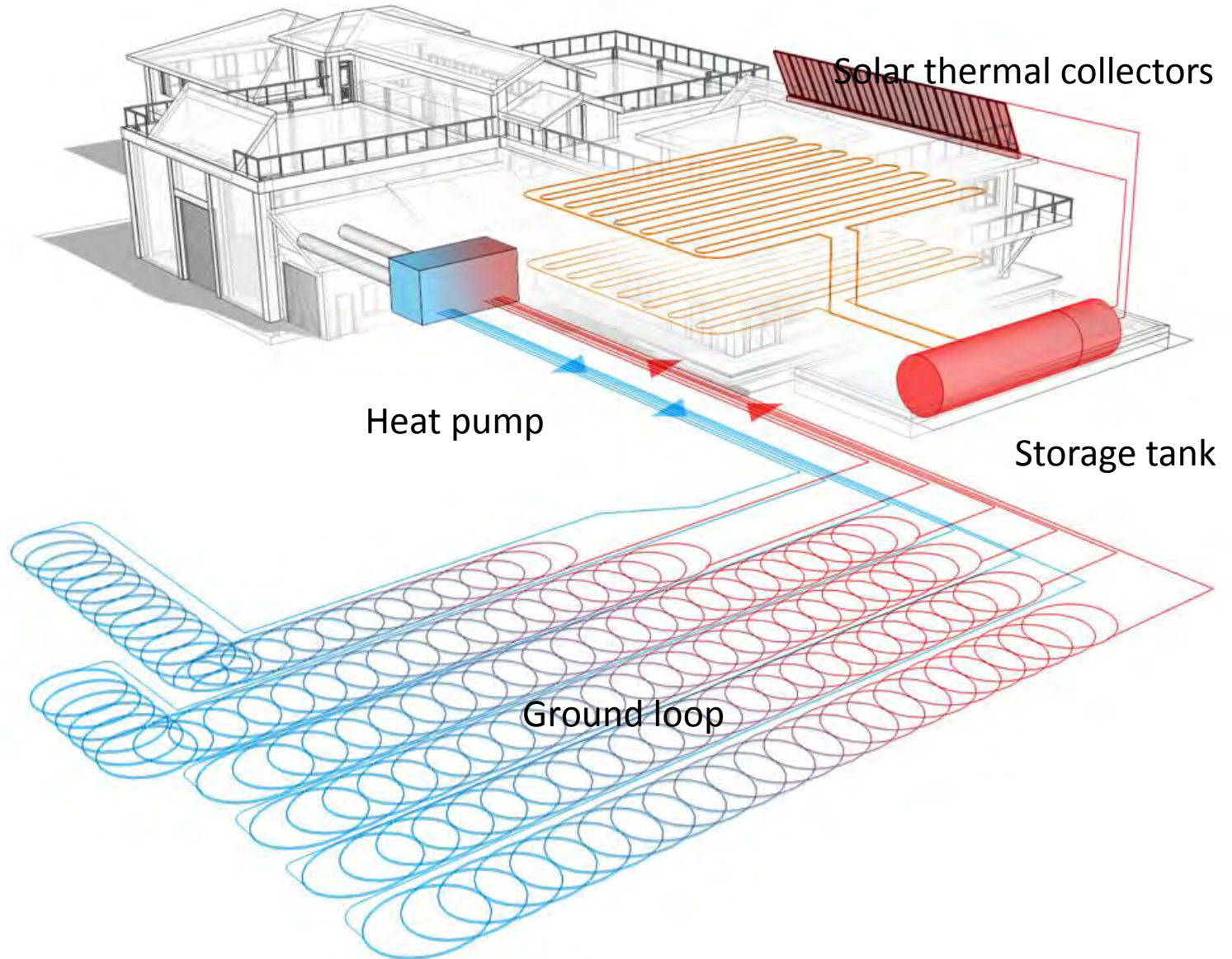
Farthest north LEED Platinum building in the world



# Solar Photo-voltaics



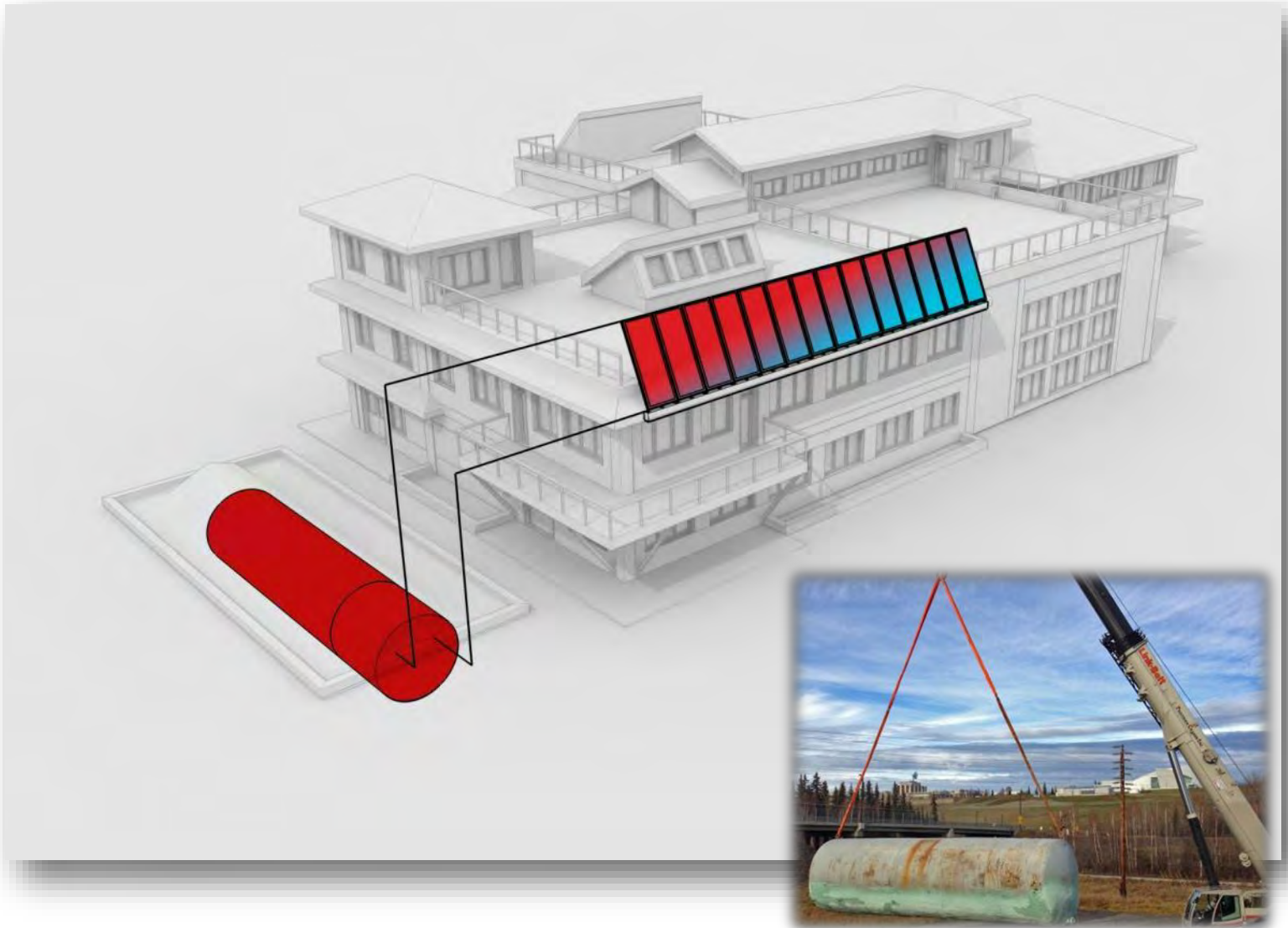
# Energy Systems at CCHRC



# Solar Hydronic



# Seasonal Thermal Storage



# Pellets and Biomass

80% combustion efficiency



80-85% combustion efficiency





# Sustainable Northern Communities

## A HOLISTIC APPROACH

Only through a holistic approach can we create healthy, thriving, sustainable communities.





# Sustainable Northern Communities

## A HOLISTIC APPROACH

### Oscarville – A Pilot Project

*Creating a new perspective one community at a time*

*Only through a holistic approach can we create healthy, thriving, sustainable communities. This concept has brought together some of the important pieces of a healthy community – residents and their culture, housing, energy, infrastructure, water/sewer, community health and economic development.*



Board Road Community



Yu'pik Culture

**ISSUES:**

- No Water Source
- No sanitation
- Landfill too close
- Honey Bucket disposal
- Inefficient Housing
- No fuel storage
- Climate change

**AGENCY PARTNERS:**

Oscarville Traditional Council

- |             |         |           |
|-------------|---------|-----------|
| CCHRC       | USDA-RD | WHPacific |
| HUD         | Nuvista | YKHC      |
| WELLS FARGO | DOE-IE  | UAA-CED   |
| RCAC        | AEA     | DCCED     |
| AVCP        | ANTHC   | AHFC      |
| AVEC        | HUD     | LKSD      |



# Sustainable Northern Communities

## A HOLISTIC APPROACH

### SECURITY, RESILIENCY, SUSTAINABILITY

Community Engagement – Multi-agency Approach – Economic Development – Phased Prioritized Projects



Shishmaref, Alaska  
Photo Credit: Arctic Photo



Kivalina, Alaska  
Photo Credit: Flickr



Newtok, Alaska  
Photo Credit: NYTimes



Our Past



Their Future

# Qagaasakung, Quyanaq, Quyana, Mahsi', Gunalcheesh, Haw'aa, Merci!



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