Energy Efficiency Alternatives for Historic Buildings in Extreme Cold Weather Climates

Buckner Building. Whittier, Alaska. Photo by Gabor Eszes.

STEP 1

Identify Historic Features

1. Exterior aspects
2. Visual character at close range
3. Interior spaces

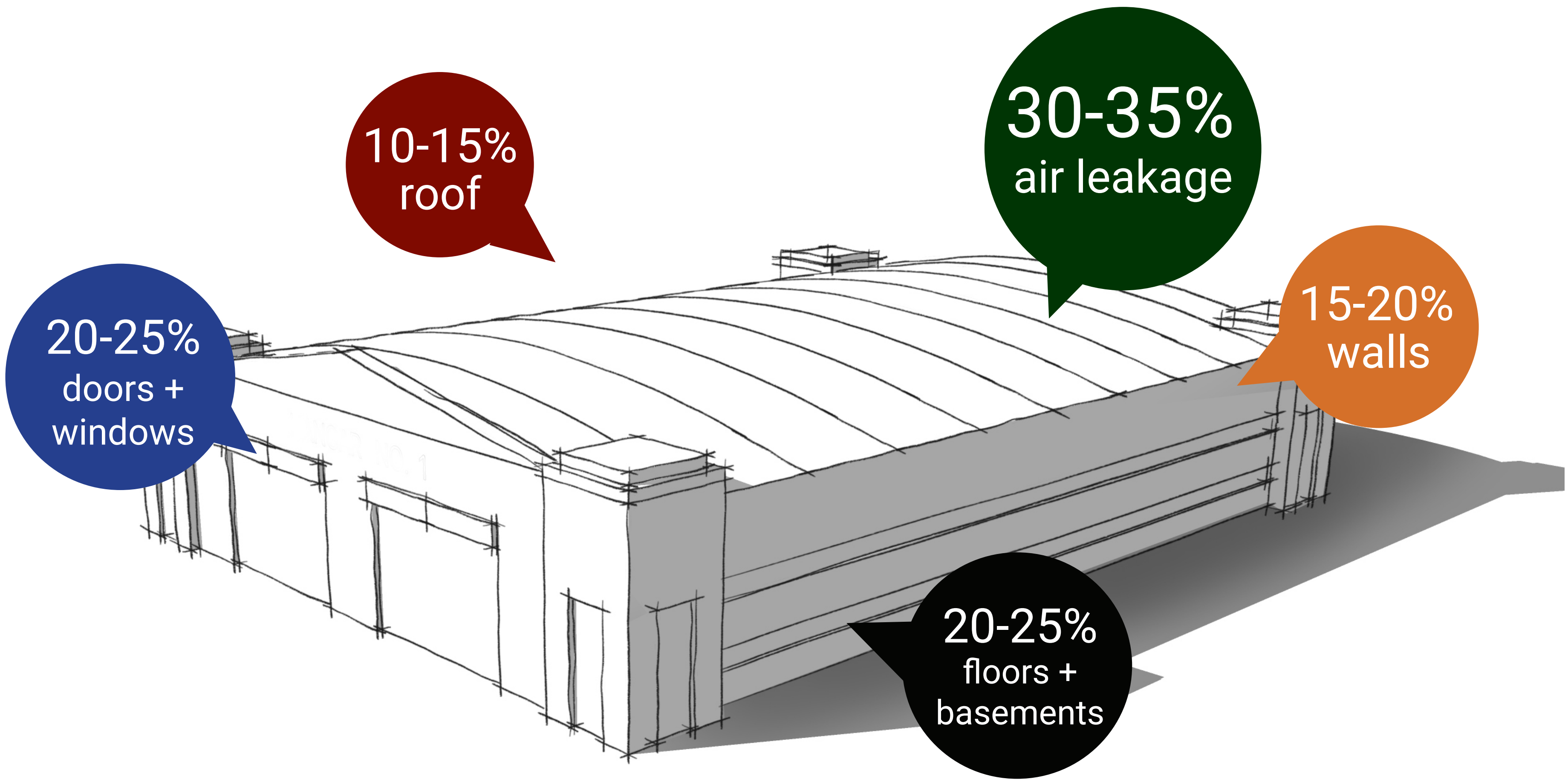
Murphy Hall, Ladd Field, Alaska. Photo by Cold Climate Housing Research Center.

STEP 2

Determine Your Building's Energy Use

Before doing an energy retrofit, it is important to understand the energy flow in the building.

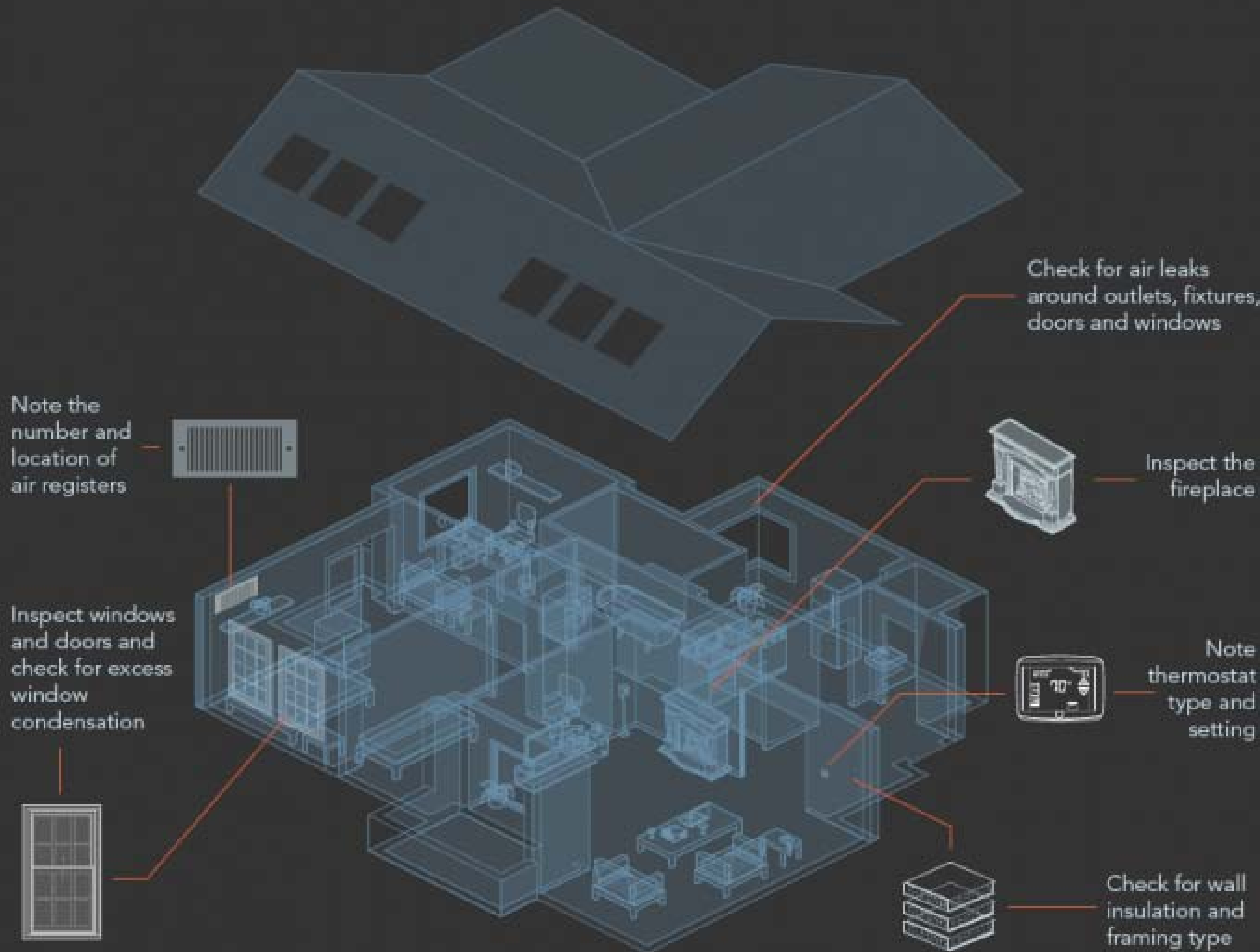
In cold climates, space heating generally makes up the biggest chunk of energy use. However, some buildings may be better served by reducing electrical or water use.



*Heat loss percentages are estimates from the Alaska Residential Building Manual, Seifert, ed. (2007) and not specific to any building.

Perform an Energy Audit

Any building in line for a retrofit should first have an energy audit. An energy audit is a systematic inspection of a building that evaluates the building's current energy use and potential energy saving options.



TESTS PERFORMED

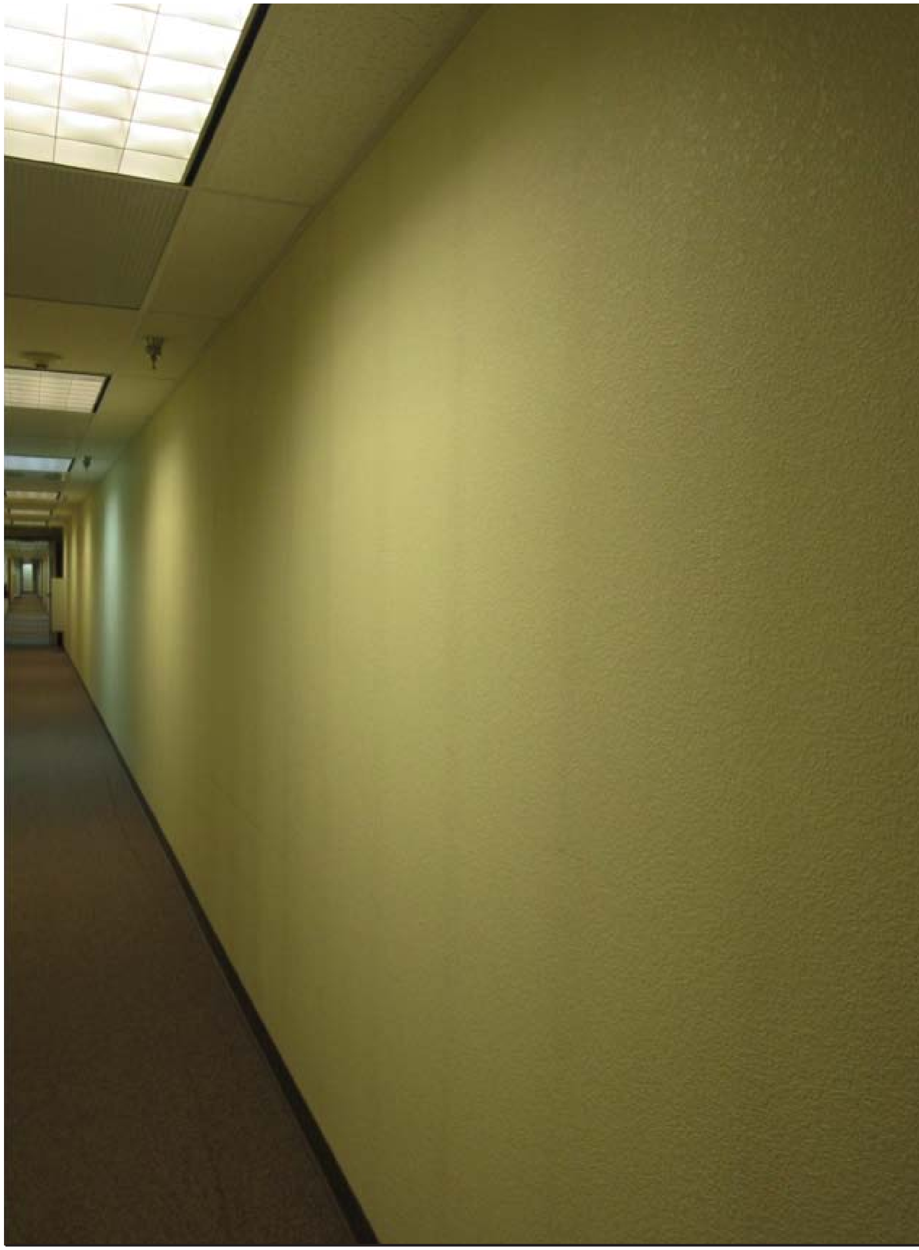
1. Blower door test
2. Infrared Imaging
3. Energy Modeling

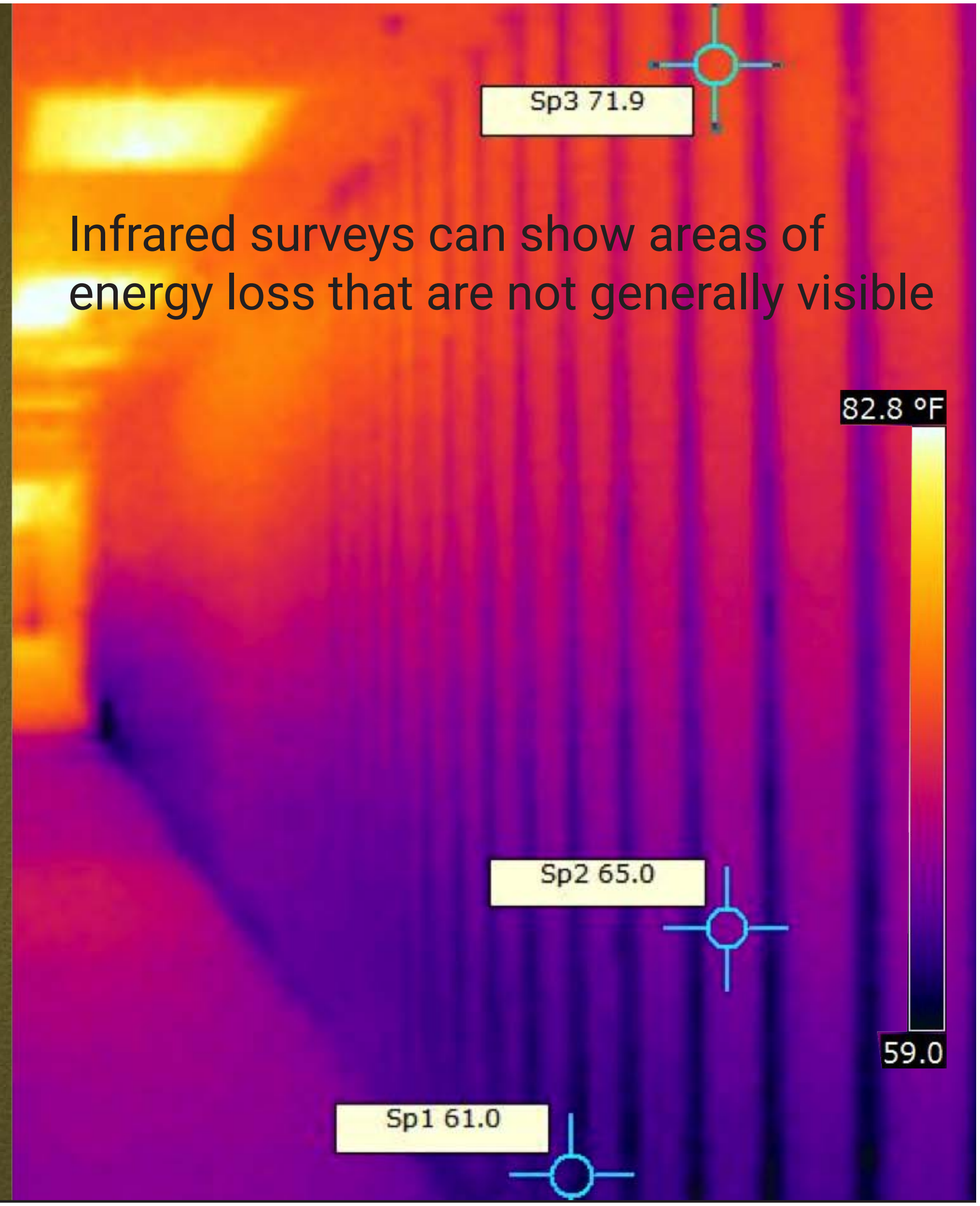
INFO PROVIDED

1. Current energy evaluation
2. Air leakage
3. Cold spots
4. Appliance efficiency
5. Recommended improvements + cost-benefit estimates

Graphic by U.S. Department of Energy

Analyze Audit for Weaknesses in the Envelope





Infrared surveys can show areas of energy loss that are not generally visible

STEP 3

Perform a Cost-Benefit Analysis

Will the change pay for itself? It's important to perform a cost-benefit analysis of any recommended change to decide which retrofits to implement. An energy audit should tell you the estimated costs, expected savings and payback period of individual changes .

Installation cost divided by estimated annual energy savings

IMPROVEMENT	INSTALLATION COST	ESTIMATED ANNUAL SAVINGS	PAYBACK PERIOD
Insulate outside walls	$10,000	$2,000	5 years
Insulate attic	$5,000	$1,500	3.3 years
Upgrade to triple-pane windows	$15,000	$1,000	15 years

For resources on performing a cost-benefit analysis, visit www.pnl.gov/feds

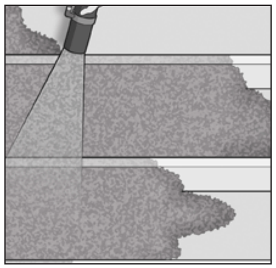
STEP 4

Design & Implementation

- DESIGN ENERGY EFFICIENCY STRATEGIES
- IDENTIFY HAZARDS & MITIGATION MEASURES
- CONSTRUCTION

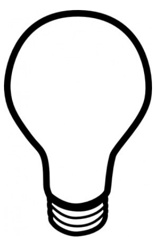
Match Energy Upgrades with Historic Features

SIMPLE STRATEGIES

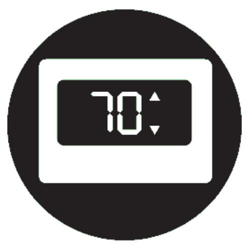


insulating attic & foundation

air sealing

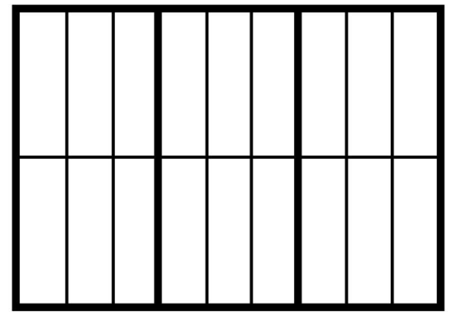


lighting

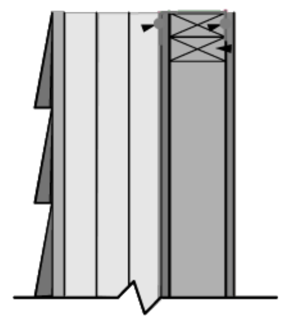


controls

QUESTIONABLE STRATEGIES



window replacement



exterior insulation

For guidance, contact the State Historic Preservation Office at dnr.alaska.gov/parks/oha

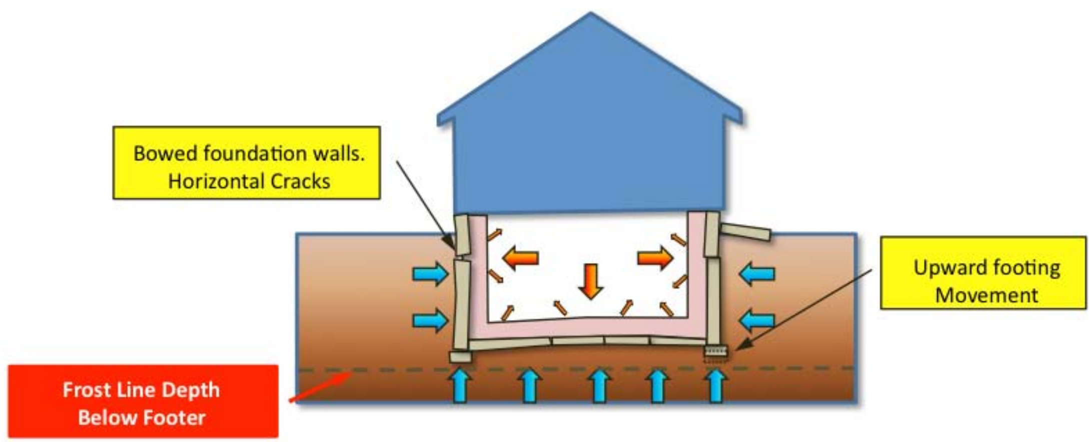
Cold Climate Considerations

Any changes to the building envelope affect how the building performs as a system.

Sealing air leakage can create indoor air quality problems by allowing excess humidity and pollutants to build up. Air sealing must be coupled with ventilation to ensure healthy indoor air quality.

Adding insulation to the walls must follow building science best practices to avoid problems in the building envelope like condensation, mold, and rot (See image on the left.) These guidelines vary by climate.

Insulating in and around the foundation requires knowledge of the surrounding soils and building science principles. Applying insulation without understanding the foundation system can lead to moisture concerns in the foundation walls, as well as frost heaving from the surrounding soils. (See below.)

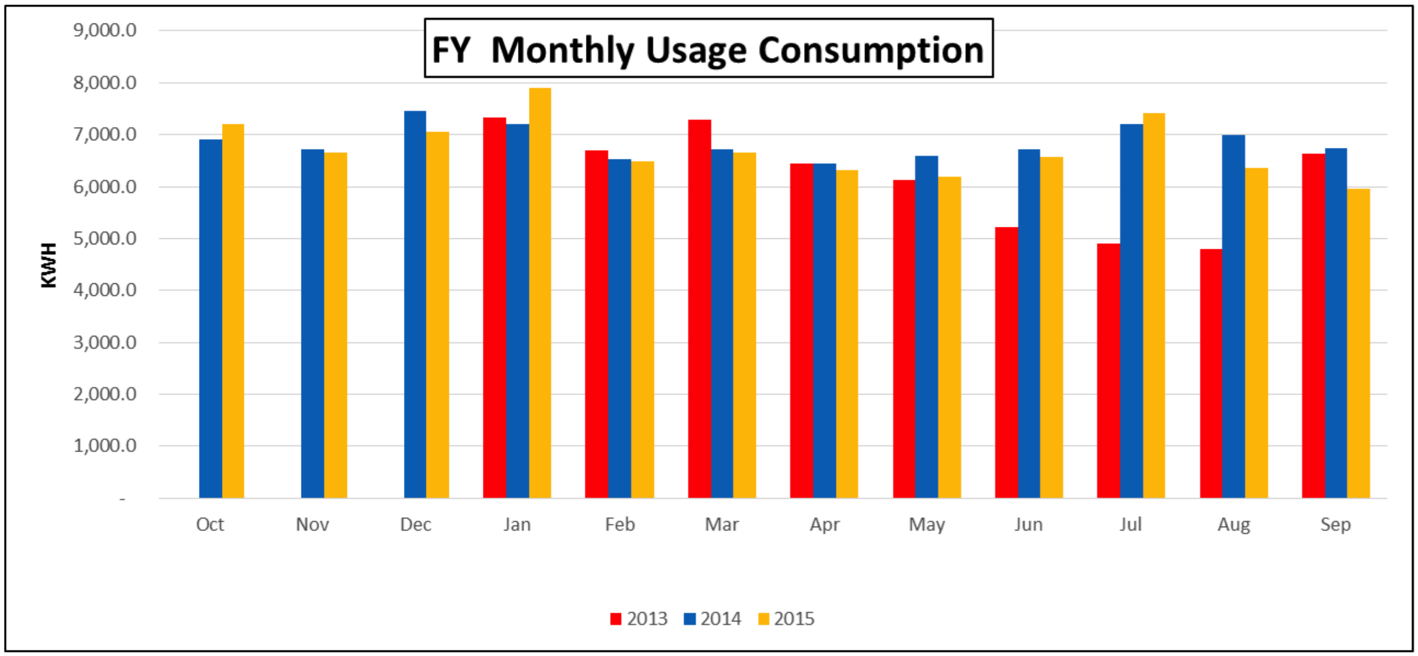


STEP5

Follow-up Monitoring

Make sure changes save energy and do not adversely affect the building

- Commissioning new building controls
  e.g. thermostats, occupancy sensors
- Educate occupants on new systems
- Track energy use post-retrofit



Case Study: Ladd Field, Fairbanks, Alaska

Ladd Field National Historic Landmark (NHL) is located on Ft. Wainwright, Alaska. It was constructed in 1938 as part of the U.S. Army's defense build-up during World War II. During the war, Ladd Field was the headquarters for the Alaska-Siberia Lend-Lease route, which sent aircraft to the Soviet Union for use on the eastern front of the war.

Today there are 30 historic buildings that make up the NHL, laid out in a horseshoe formation around the runways. Hangar 1 is on the south end of the horseshoe, and a ring of barracks that are now being used as offices is on the north end.

The Cold Climate Housing Research Center made a site visit to Ladd Field to evaluate the energy efficiency of the buildings. The short site visit served to inform us about the building and allow for us to make suggestions to lower energy use. A formal energy audit is needed to come up with precise strategies and cost-benefit analysis.

The pictures on the right show the north side of Hangar 1. The infrared image shows heat loss through the building envelope. The yellow colors show the warmest parts of the building. As you can see in the regular picture, the brightest yellow spot is around the fire alarm. These photos suggest that when the alarm was installed, a hole was cut into the wall and was not air sealed. Warm air is leaking out of the hole and heating the outside of the building.This is just one example of the large amount of air leakage from the building (the ice on the roof is another result of air leakage through the ceiling).

Stopping air leakage from the building envelope is often the simplest and most cost-effective energy saving option. In the case of historic buildings, it has the added advantage of not altering the exterior look of the structure.