

Nightmute Whole Village Retrofit – Then and Now

January 15, 2015

By Katie Conway, Alaska Energy Authority

Executive Summary

On November 5, 2014 Alaska Energy Authority (AEA) led a multi-agency team of nine people on a return visit to the small, southwest Alaska community of Nightmute to investigate the impacts of the Whole Village Retrofit (WVR). The WVR was a collaborative pilot project undertaken in 2008 and 2009 with the intention to test what would happen if all available energy cost saving resources were deployed in the same place at one time. The Village Energy Efficiency Program (VEEP), then called the Village End Use Efficiency Measures (VEUEM) program, implemented building envelope and lighting upgrades to thirteen community buildings. Residential Weatherization (Wx) improved 34 homes. In addition to the energy efficiency (EE) improvements, additional aspects of the WVR included an intertie to neighboring wind-powered Toksook Bay, a powerhouse upgrade and downsizing (it was made a backup generator), and the installation of smart meters in all buildings. Building efficiency improvements alone were estimated to save roughly half of pre-retrofit heating fuel. After the work was completed in 2009 there were no follow up visits or other WVR-related communication with Nightmute to find out if estimated savings turned out to be real savings. In light of the increasing importance of EE as an energy cost reduction solution, especially for remote communities with few other options, AEA decided it was time to revisit the Nightmute project to find how well the WVR model worked, and how replicable it might be elsewhere.

Key Findings

The Whole Village Retrofit was a successful effort that seemingly met the project deliverable: energy costs were reduced. Despite our best intentions we cannot measure the full extent to which energy costs were reduced because of insufficient, inconsistent data so are left using a combination of estimates made upon project completion in 2009 and anecdotes heard recently on the 2014 community visit. Our investigation of the project's impacts explored only the residential and non-residential building efficiency improvements, not the other aspects of the WVR project. Following is a list of evidence-based key findings from a comprehensive analysis of the return trip to Nightmute, conversations with external stakeholders at an October, 2014 Whole Village Retrofit Working Group meeting, and the initial WVR VEEP project final report.

1. **Energy Efficiency works.** While we weren't able to quantify savings because fuel records were insufficient we did hear anecdotally about the significant cost savings and improved comfort due to EE measures implemented during the WVR. Residential Weatherization and VEEP are effective tools for reducing energy bills, improving indoor air quality (IAQ), and extending building life. Inspection of the non-residential building efficiency improvements showed measures to be intact and performing as

intended. Likewise, Wx measures provided for Nightmute homes are continuing to provide for reduced energy burdens and better IAQ for the residents.

2. **Community partnerships are important.** One of the things that worked so well about the WVR VEEP project was early, extensive community engagement and subsequent local support for and participation in the building efficiency improvements. VEEP's scope of work was largely determined through a local vetting process that included early meetings with the community at large as well as with individual community entities. Community entities contributed cash and in-kind matches that expanded VEEP's scope of work by nearly half. We can infer that community entities were more willing to have skin in the game because the projects were defined by local need. This success is a lesson in the value of facilitating community-led, community-oriented projects.
3. **Good data is hard to come by.** One of the primary objectives in returning to Nightmute in 2014 was to collect enough data that we could measure actual energy and cost savings due to the WVR. Unfortunately, despite all our best efforts, that data simply does not exist. Direct confirmation of heating fuel savings due to the WVR was impossible due to the lack of heating fuel records for the community buildings. No buildings had complete heating fuel consumption data for the years before and after the retrofits. Because of this, and the lack of any information concerning the use of the building, we have to rely on the modeled results to estimate the energy savings. Likewise, AEA was unable to gather electricity consumption for the years pre- and post-retrofit to validate the expected savings. Especially with no knowledge of how the buildings were used before and after the retrofit, it would be difficult to ascertain the true savings. Given that the building improvements, including lighting upgrades, were generally working as intended, it is fair to assume that the estimated heat and electric savings post-retrofit are reasonably accurate.
4. **There's always more to do.** Significant energy and cost savings measures were implemented during the WVR, and by all accounts seem to be holding up well in Nightmute's homes and community buildings. However, nearly all the buildings that were improved by the VEEP portion of the WVR were named as buildings that need work done now. A similar story was heard during the residential Wx home surveys. This is not likely symptomatic of failures with the implemented measures. Rather, given the poor starting point of the buildings' condition in 2008-2009, even with significant improvements, the forces of nature continue to take their toll and sometimes measures are not adequately maintained by building occupants. It seems there will always be more work to do to maintain or improve the energy efficiency, and sometimes just habitability, of buildings.
5. **Simultaneous projects are not necessarily beneficial.** We found no discernable benefits to deploying residential and commercial weatherization at the same time. If anything, doing these two things at the same time could have negative consequences: competition for a limited local workforce, overwhelming the community's ability to house or feed visitors, and a lack of local capacity for managing multiple projects at once are all potential risks. In Nightmute, residential weatherization and VEEP were seemingly successful independently of one another.
6. **Five years is a long time.** It had been five years since the WVR had wrapped up in Nightmute when the team visited in November, 2014 to assess the project's impact. Community leadership has changed significantly. People have come and gone from the village. Homeowners and building occupants might not remember everything accurately from what took place five years ago. While some in the community were able to recall quite well very specific details of building work done during the Whole Village Retrofit.

Recommendations

Findings from Nightmute can be applied to future projects to improve efficiencies in time and cost to maximize investments made by stakeholders and contribute to greater, longer-term project success.

- A. **Strategic coordination.** Interagency coordination and community partnerships were a core component of the WVR. Initial WVR project partners, both external and community entities, signed a Memorandum of Understanding (MOU) to declare commitment to the project. This was a good way to formalize and acknowledge community participation as well as to document cost-sharing commitments from all partners. In the future, however, it may not always be worth the time and trouble to go through the MOA process. In other instances, it might be beneficial to align schedules related to specific types of improvements. For instance, RurAL CAP's Energy Wise program might be a good compliment to Residential Wx, and perhaps there's a way for a smaller project to merge with a larger one on a similar timeline to maximize economies of scale. Coordination should be more an exercise of capitalizing on opportunity rather than creating it, and components of a WVR should be spread out strategically over a longer period of time as a sequence of energy and cost saving efforts.
- B. **Clear communication.** Collaboration relies on good, sustained communication between all partners, including local, regional, and state entities. Improved communication, transparency and a culture of inclusiveness for any community-based projects could increase our ability to identify and act upon collaborative opportunities such as cost-sharing and resource-optimizing scheduling.
- C. **Sustained community engagement.** The Nightmute Whole Village Retrofit started with successful community engagement which, presumably, had a positive impact on the shape and size of the project. Five years is too long for a post-project follow up, when people might not remember as well what was done or the impacts that work had on their lives, and when it's too late to make small adjustments to implemented measures to preserve their integrity instead of falling into irreversible disrepair. We should make a point of returning to the community to assess our work a year after the project has been completed. On a post-project inspection we could provide consumer education to building occupants or owners on the best ways to maintain the measures implemented to ensure our investment in building improvements is maximized and the recipient homeowners or community entities also receive maximum benefit. Additionally, a return visit would give the implementing agencies an opportunity to evaluate the measures implemented and perceptions of project impact from the community for quality assurance and continual improvement of the services we deliver to the people of Alaska.
- D. **Facilitate consistent, accurate data collection.** The lack of quality end-use energy data in rural Alaska is a reoccurring issue. Without having a good baseline of energy use, it's difficult to measure the impact of any energy efficiency measure implemented as a part of a project, which makes it difficult to quantify real savings. AEA and other agency stakeholders could develop a simple, user-friendly standardized fuel data collection form for tracking public building heating fuel use, and mandate regular reporting of heating fuel use, using the form, upon receipt of any agency funding. AEA could request other funding agencies to do the same in order to institutionalize a better methodology for tracking rural community heating fuel use. The Power Cost Equalization (PCE) program is a successful example of community energy tracking. Because of data gathered through the PCE program we are able to infer a lot of information about a community's electricity use over time. If we could figure out a way to gather heating fuel data in a similar way we would likewise have the ability to infer a lot about a community's heating fuel use. This is a critical next step in delivering better energy and cost saving programs to rural Alaska.

THEN: Whole Village Retrofit (WVR) 2008-2009

What was the WVR project and why was Nightmute selected to pilot this model?

- The Village End Use Efficiency Measures (VEUEM) program was three years into operation (the program began in 2005). These were mostly lighting upgrades and basic weatherization improvements to public buildings and facilities in rural Alaska. Funding came from the Denali Commission. VEUEM is the precursor to the Village Energy Efficiency Program (VEEP), which is a current AEA program.
- AEA and AHFC, as well as other energy efficiency implementation entities, thought it might be interesting to see how much total energy cost savings could be realized for a community by undertaking VEUEM simultaneously with residential Weatherization (Wx). Interest in maximizing the value of efficiency improvements came in the wake of the highest oil price spike in world history, and the resulting devastation to rural Alaska communities heavily reliant on expensive diesel fuel for heat and power. Project visionaries wanted to find out what it would mean for a community if all possible EE programs were deployed at the same time.
- Nightmute was selected for the Whole Village Retrofit pilot project for several reasons:
 - **Good timing:**
 - Residential Wx was already scheduled to take place during the 2008 and 2009 summer project seasons
 - An intertie was in the process of being constructed, linking Nightmute to Toksook Bay and their wind generation
 - AVEC had Denali Commission money to improve Nightmute's power house, downsizing but upgrading the quality of one back-up generator
 - **The right size:** Nightmute, at a population of just under 300 people, is a good representation of a rural Alaska community.

Core components of developing and implementing the Nightmute WVR pilot project:

- Interagency coordination: It took six months to draft up and finalize a Memorandum of Understanding (MOU) between the participating entities.
- Community engagement: ABSN kicked off the VEEP aspect of the WVR with a community meeting to discuss and determine project scope based on community needs and priorities
- Community building energy efficiency improvements
- Residential weatherization

Timeline:

- Project organization began: September 2007
- MOU with project partners: process began 9/2007, signed 3/2008
- Contract with ABSN: already in place with AEA for VEUEM project management
- Materials ordered and shipped: winter/spring 2008
- Construction: began summer 2008, completed summer 2009

Buildings Improved:

Building	Ownership	Improvement
34 Homes	Private	Wx (RurAL CAP)
City office	City of Nightmute	Wx & Lighting (ABSN)
Community Hall	City of Nightmute	Wx & Lighting (ABSN)
Head Start Bldg.	City of Nightmute	Wx & Lighting (ABSN)
PAP/Public Safety Bldg.	City of Nightmute	Wx & Lighting (ABSN)
Post Office	City of Nightmute	Wx & Lighting (ABSN)
Water Treatment Plant	City of Nightmute	Lighting (ABSN)
Warm Storage Building	City of Nightmute	Lighting (ABSN)
NTC Office Bldg.	Native Village of Nightmute	Wx & Lighting (ABSN)
Umkumiut Office Bldg.	Native Village of Umkumiut	Wx (ABSN)
Chinuruk Village Store	Chinuruk, Inc.	Wx & Lighting (ABSN)
Community Church	Nightmute Community Church	Wx & Lighting (ABSN)
Church Housing	Nightmute Community Church	Wx & Lighting (ABSN)
School Gym & 4 Teacher Housing Units	Lower Kuskokwim School District	Lighting (ABSN)

Project partners and roles:

- AEA – project lead
- AHFC – initial coordination
- AVEC – installed smart meters in every building
- Chinuruk, Inc.: \$34,000 match for measures to village corporation's store
- AVCP Housing Authority – planned to weatherize non-Wx eligible housing but work did not happen
- Community of Nightmute – active participant in Wx work, contributed a cash/in-kind match that increased scope of work for non-residential EE by over 45%
- Denali Commission – funded smart meters, intertie and power house improvements
- RurAL CAP – residential Wx implementing entity
- Alaska Building Science Network – AEA contractor for commercial building EE implementation and project management

Money invested for building EE improvements:

- AEA grant implemented by ABSN: approx. \$165,000
 - RurAL CAP Wx: \$435,830
 - Village entity admin and coordination: \$8,000
 - Chinuruk, Inc.: \$34,000 match for measures to village corporation's store
 - Nightmute Community Church: \$21,700
 - City of Nightmute: \$4,700
 - Umkumiut Native Village: \$2,000
 - Nightmute Native Village: \$400
 - Other, in-kind barge, freight, etc.: \$7,800
- Total community funding contribution of \$75,700 expanded total program budget by 46%.

EE Work completed:

- 34 homes (64% of total housing) weatherized by RurAL CAP
- 10 community buildings weatherized and given lighting upgrades by ABSN
- School lighting upgrades
- 4 Teacher housing units lighting upgrades

Total estimated savings from lighting upgrades:

- 15.68 kW of displaced electrical load
- 26,830 kWh per year
- \$14,244 per year
- Estimated 4.7% of total village-wide electric consumption saved
- Simple Payback: 4.62 years

Residential Wx measures implemented:

- Some initial roofing and foundation repairs (critical work identified during this project and completed out of necessity even though it was outside project scope)
- Exterior rigid foam insulation installed on floors and walls
- R-7.5 extruded blue or pink foam boards
- Air-sealing
- Blown loose-fill insulation to attics R-40
- Some window and door replacements

Residential Wx estimated total savings:

- Budget for materials, labor, shipping: \$435,830
- Total annual gallons fuel saved for all 34 homes combined: 4,575
- 2008 village fuel price/gallon: \$7.90
- Comprehensive annual dollar savings: \$36,143
- Average annual fuel savings per home: \$1,063, or about 50%
- Simple payback on project funds: 12 years

Community buildings Wx measures implemented:

- Some initial roofing and foundation repairs
- Exterior rigid foam insulation to parts of floors, walls or ceilings in 3 buildings
- R-10 extruded blue or pink foam board
- Air-sealing
- Blown loose-fill insulation to attics: R45-R50
- Replaced one door

Community buildings Wx estimated total savings:

- Approximately 56% total fuel savings (average per building annual use went from \$5,096 to \$2,205)
- Payback on just air sealing and attic insulation in five buildings, including ABSN and community funds: 6.7 years, or for just the community investment a 1.6 year payback.
- Projected annual fuel savings to village corporation store: \$10,639 (\$6.60/gallon). That's an 8.3 year payback calculated with both ABSN and Chinuruk financial contributions, or for just the village corporation, a 3.2 year payback.

- Total cost: \$240,700 (including community contributions)
- Annual gallons fuel saved (counting only nine of the ten buildings): 4,834
- Annual dollar savings (at \$6.60/gallon): \$31,904
- Simple payback on ABSN and community funds: 7.5 years (5.2 years for ABSN investment, 2 years for Nightmute investment)

Miscellaneous information:

- There was no concerted effort to maximize economies of scale with the purchase or shipping of materials. Each program managed logistics independently of the others.
- The VEEP project hired a local crew that ranged in size from 12 to 14 individuals over the course of the two year project.
- Wx employed a local crew as well, likely about 20 individuals.
- AVCP Housing Authority signed on as a project partner with the intention to weatherize homes not eligible for Rural CAP weatherization. Work did not happen.

NOW: 2014 WVR Reboot

Given the increasingly important role of energy efficiency and conservation as an energy cost reduction strategy, especially for places that have few or no other options, AEA decided it was time to return to Nightmute to learn how we can do better next time. Preceding the site visit AEA convened a group of stakeholders, the WVR Working Group, to discuss the trip itinerary and anticipated outcomes. Feedback from this group has been incorporated into the findings section.

Date of Site-Visit: November 5, 2015

Purpose of trip: To help find answers to the following questions:

1. What were the expected, perceived, and actual benefits and costs of the Whole Village Retrofit project in Nightmute?
2. Is it worth replicating the Nightmute WVR model in other places?
3. If yes, then how do we do it?
 - a. What circumstances are required in order for the WVR model to be implemented?
 - b. What improvements can we make to the model?
 - c. What organizations should be involved in the collaborative process?
 - d. How do we align schedules to most effectively maximize economies of scale?
 - e. What are the barriers to successfully implementing the WVR model in other communities and how do we overcome them?

Who went:

1. Katie Conway, AEA
2. Rebecca Garrett, AEA
3. Scott Waterman, AHFC
4. Kent Banks, Rural CAP
5. Jack Hebert, CCHRC
6. Geoff Butler, Energy Efficiency Services
7. Tiffany Zulkosky, Nuvista

8. Brent Latham, AVCP
9. Molly Rettig, CCHRC

Schedule:

6:20 am – 7:33 am	ANC to Bethel on Alaska Air
	Strategy session while waiting in Bethel
9:00 am – 10:00 am	Charter flight from Bethel to Nightmute
10:30 am – Noon	Community meeting/listening session
Noon – 5:00 pm	A: building walkthroughs, inspect implemented measures, blower door test (Geoff, Scott)
	B: door-to-door residential survey (Kent, Jack)
	C: interviews with non-residential building representatives/community leadership (Tiffany, Katie, Rebecca, Brent)
5:00 pm – 6:00 pm	Charter flight from Nightmute to Bethel
6:00 pm – 8:30 pm	Team dinner and debrief in Bethel (“what I learned today” roundtable)
9:35 pm – 10:40 pm	Bethel to Anchorage on Alaska Air

Detailed schedule:

1. Flew Anchorage to Bethel on the 6:10 a.m. flight. Arrived Bethel, collected luggage, caught a shuttle to the Grant Aviation hanger, checked in for the charter flight. We had a little over an hour to kill before departing for Nightmute. Grant Aviation kindly let us use their pilot’s room to have a team meeting.
2. In our meeting we introduced ourselves and talked a bit about the day’s objectives. Jack and Kent would do the door-to-door-surveys with the help of Katy Tony, the Umkumiut tribal administrator. Scott and Geoff would investigate the work done to commercial buildings, including several blower door tests. Rebecca, Tiffany, Brent, and Katie would talk with community leaders about efficiency opportunities and perceptions of the work done in 2008/2009. Molly would film various aspects of the day.
3. We departed Bethel while the sun was rising, at about 9:00 a.m., and arrived Nightmute at about 10:00. We were met at the airstrip by several people with four-wheelers who transported us and our gear to the community center/Bingo hall where we began preparing for the community meeting. We heard that there had been several announcements made over the radio already that day about the meeting, and the flyer Katie sent out the week before was hanging all over the community. To prepare for the meeting we set out the meeting snacks we brought with us and made coffee.
4. The community meeting was well attended; there were about 30 local people there, plus our 9 person team. Conversation started with a brief introduction from Katie Conway and then Jack Hebert. Right off the bat we heard feedback on the Residential Wx effort from 2008/2009. There were no pauses in talking – someone always had something to say, and most of it was about the residential efficiency projects of the WVR. The feedback we heard about Wx was mostly negative. Kent took a lot of notes, while Jack facilitated this part of the meeting. At one point an elder spoke out in Yupik telling people to be honest, that there was value in us hearing the real story. The only feedback we heard about the commercial building weatherization or lighting upgrades was in regards to the church, and it was very positive.
5. At the end of the community meeting folks in the room who were going to have their homes assessed and be interviewed by Jack and Kent (see Appendix B) met with that pair to figure out the order in which they’d be conducting their walk-throughs. Scott and Geoff left to begin a blower door test on the Head Start building (See Appendix A). Katie, Rebecca, Brent, Tiffany and Molly went to talk with the Mayor and City staff at the City Building. From there each of the three groups kept to separate agendas for the rest of the day. The team reunited at the school at 4:00 to return to the airplane and fly back to Bethel.

6. We returned to Bethel at about 5:30/6:00, flying during sunset. After checking in for our return flight the team debriefed over dinner at a local restaurant. We took a taxi back to the Alaska Airlines terminal at about 8:00 for the 9:15 flight back to Anchorage.

Qualitative findings:

(This section incorporates notes from Katie Conway and Scott Waterman)

- People generally had a lot more to say about the residential weatherization work done as a part of the WVR than anything else. We heard comments at the community meeting suggesting that work on some homes may have been less than ideal, though it's important to remember that meeting attendees were a self-selected sample of the whole residential Wx participant pool, as were participants of the residential walk-through and interview by Jack and Kent. These may have been motivated to participate in the community meeting and/or walk-through by less than desirable results from the 2008-2009 Wx. They may not be a representative sample of community perceptions.
- Commonly heard concerns regarding residential Wx included:
 - Crews being forced by the Rural Cap construction manager to work too quickly at the expense of quality work
 - There wasn't enough initial research into local weather conditions so work done was not necessarily appropriate for Nightmute's unique circumstances
 - Not enough initial community involvement
- Five years is a long time for folks to remember what was there before. Some do, but few pay close attention to fuel bills over time. Most can compare this winter to last winter, but without records, few can track what happened six years back compared to today. The Weatherization (Wx) program has long experienced an element of the recipients who feel that once the home has been served, more can always be done. When returning to a community after one or more years have passed, there is a feeling among Wx agency folks like the "Adopt a House" mentality pervades some of the recipients.
- Changes in the Wx program have eliminated most work on foundations. In prior years, much effort and expense was incurred to repair or replace cribbing and foundation members, and raise and level the building. This was tremendously expensive and discontinued due to costs, but the penalty is that homes are not level, and fitting windows and doors can be problematic on shifting soils.
- Quality Control - House wraps consisting of 2" rigid insulation and new T-111 siding were inconsistently applied in Nightmute. Wind and other pressures have loosened the fasteners used to hold the new siding on and some of the siding was not securely attached to the home. I think some real world research is needed. In the past there have been some issues with water penetration from the exterior on homes where insulation/siding were applied. Flashing and detailing around windows and doors is critical to prevent water intrusion. Yet little evidence has been shown there are condensation issues when a vapor barrier was applied on the warm side of the insulation. RuralCAP has since discontinued the use of these wraps in most cases for Wx projects.
- Ventilation and Indoor Air quality has long been a problem in rural Alaska. Homes have ventilation, but electricity costs are high, and people often don't want to use mechanical ventilation because of the cost of operations. The ventilation equipment used by the Wx program is ultra-efficient using only 13 watts per hour when in operation. This is sufficient if used for only a few hours per day. When occupants don't use these fans, mold can develop and clients complain. Education to homeowners is provided at the time of installation, asking them to keep the fans on, but some homeowners see the cost to using them may be higher than perceived benefits. This problem is exacerbated when HRV's are installed, which is why the simple, lower wattage fans are installed.

- Local hire – Factions within a community can undermine quality in some homes. Expectations are often unrealistic. Some people seem to think that weatherization services are for life, not the scope of the project.
- For information about the performance of measures in commercial buildings we'll need data from the blower door tests and with any luck, heating fuel bills. It was very hard to get information from people in the community for a number of reasons. One, there's been a lot of turnover within community leadership. Folks who were involved back in 2008/2009 weren't around on our November 5th site visit. Also, not everyone understood what we were talking about. Not everyone was aware of all that took place during the WVR.
- Despite the lack of consistency in awareness about the WVR components or what efficiency really means, there were some consistencies in feedback about what's most important in ensuring success for a project like this. First, there needs to be a lot of community involvement from the very beginning of the project. Second, the local community needs to be more involved as a work force, actually implementing measures. Third, the implementing agencies need to do a better job of informing the entire community about what's being done, why, where, how, and when. This is feedback that has relevance for a lot of our programs, not just the potential for future WVR efforts.
- Government funded projects often drop into a village like balls falling from the sky. Community leaders and residents are often not aware of what will happen until it does. There has long been conversation about state and federal agencies working together, which sounds great in concept. But coordinating budget cycles, funding sources, labor, materials and myriad other parts and pieces of the game, is not simple, or sometimes even beneficial.
- There are economies of scale when a small project can be incorporated into a bigger one. Mobilization costs, shipping costs and project costs may be reduced somewhat, but huge obstacles need to be overcome. One of the easier ways to do this is to sub-contract the work on smaller projects to the larger contractor, rather than bringing in additional crews. E.g. if a RuralCAP or AVCP type weatherization project is scheduled, say at \$900,000 and there are additional funds to retrofit some community buildings of say, \$100,000, subcontracting the community building work to the Wx provider would give some definitive economies of scale, and allow for additional measures to be implemented on both projects, for the same amount of money.
- Local planning is key – coordinating community action/non-governmental organizations, state and federal agencies is a good idea when it can work. It becomes much easier when a local planning effort identifies what is truly needed for the community. From a local planning effort, needs and priorities can be established. These relate to food, subsistence, energy, housing, education, jobs, infrastructure, water/sewer, communications, social problems and more. A project dropped on them like a shiny ball from the sky may fill some needs, and is not likely to be ignored, but it may not be the top priority for the community at this time, and may not be in the proper sequence for future projects, i.e., an energy efficiency project comes in before water/sewer retrofits, and much of the new insulation is torn out to install the bathrooms.
- Energy is a significant portion of budgets in every organization in rural Alaska. AHFC estimates the energy bill for public buildings in the state exceeds \$640 million annually, and about \$1.4 billion for all non-residential buildings in the state. With efficiency retrofits, a 20% savings is not hard to achieve, and with a bit of effort, 30% or more are often possible. Add in renewable energy systems and reductions or displacement of expensive fossil fuel can be 50% or more.
- What was right about the Nightmute WVR:

- Community engagement in devising the scope of the project. By including the community early on the scope of the commercial building piece of the WVR was expanded by almost half and project managers ensured that work important to the community was done. This is why the church was worked on – that's had huge benefits for the community and they're proud of it.
- What could have been better about the WVR:
 - More sensitivity to cultural/social nuances within Nightmute. Crews were asked to work faster than they were comfortable with, and project managers were unaware of how grievances between parties would play out in the implementation of work on houses.
 - More involvement of residential participants in the work done to their own homes.
 - Maybe in future efforts RurAL CAP could be a project partner to do Energy Wise hand-in-hand with home Wx for better homeowner education.

Quantitative findings

- Though we came back to Anchorage with a stack of fuel invoices from the city we were unable to discern anything meaningful from those records due to inconsistencies and insufficient data.
- AVEC records from the nine surveyed homes and community buildings did not include sufficient information to make conclusions. Data was not supplied for time before retrofits. Without a baseline we are unable to determine changes to energy use due to measures implemented during the WVR.

Appendix A:

Nightmute Whole Village Retrofit Project - Follow-up Site Visit Commercial / Community Building Inspection Report

11-26-14

By Geoff Butler, Energy Efficiency Services

After meeting with Nightmute leaders and residents at the Nightmute Community Hall, Geoff Butler and Scott Waterman spent the afternoon doing brief walk-through inspections of the various commercial / community buildings throughout the village – as many as time allowed. Photos were taken and blower door tests were performed on three of the buildings: City Community Hall, Chinuruk Inc. Store and the Nightmute Catholic Church. Where community building staff were available, we asked general questions about the current state of building performance and the energy savings measures done in 2008 / 2009. Other than for the school, no on-staff maintenance employees were available for discussions. Due to the straight forward nature of the completed energy retrofits, we were able to assess current status of the measures without working directly with maintenance staff.

During our walk-through inspections we did not have much opportunity to meet with building owners, but we did have some brief conversations and I made a few follow-up calls to get some general impressions of WVR results which I've reported below. We generally encountered office staff who were in their positions for a short time and who did not have historical knowledge of their building's energy use or performance. As such, and due to time constraints no survey questions, fuel use data or releases were obtained. Also due to time constraints we were not able to access the Catholic Church staff housing building, the Nightmute School teacher housing units or the City Water Plant or Warm Storage buildings where lighting only retrofits occurred. Considering our findings in other buildings inspected however, we are confident the energy measures performed 5 years back were holding up well and functioning as intended

Summary of Findings:

In all buildings inspected we found the energy retrofits performed in 2008 – 2009 were substantially intact and performing as intended. In all buildings, the lighting upgrades installed 6.5 years ago in June, 2008 were performing very well. Excluding just a few fixtures the linear fluorescent lights were all working and putting out adequate light levels. Lamps showed plenty of serviceable life remaining with not much graying occurring at lamp ends. Screw in bulbs, excluding one incandescent bulb found, were all compact fluorescents as installed in 2008, which demonstrates it is basically common knowledge at this point to avoid incandescent lighting!

Air sealing measures including door jamb seals and threshold sweeps appeared substantially intact. The Chinuruk Store was found to be missing door seals however, and a blower door test of this building revealed additional air leakage presumably from building settling.

Blow-in attic insulation appeared to be performing as intended, although we did not physically explore attics. Attic hatch covers had been caulked shut as intended at time of original work and we did not have time to cut caulk beads and reseal hatches. We did not observe any mold spots on ceilings which could indicate voids in blown insulation due to wind shift after installation.

If time allowed, I would have liked to access some of the attics to inspect the current condition of the blown fiberglass insulation. As part of this WVR 5-year follow-up work, I believe it would be worthwhile to work remotely with a City or other entity maintenance staff person to cut the caulk seal on a few attic hatches and get up and observe the insulation condition. This follow-up work would be valuable particularly in such a windy area as Nightmute. During the original retrofit work in '09 we installed gable end vent covers on the leeward sides of buildings where possible to discourage insulation wind-drift in attics. It would be good to know how things actually have turned out in the attics 5 years later.

Two direct-vent space heaters installed in 2009 were performing as intended.

City Owned Buildings:

COMMUNITY HALL

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures
- Air sealing, blown fiberglass insulation in attic, exterior door sweeps / seals, installed 2" rigid foam - ceiling of 12' x 48' addition, installed new Monitor direct vent space heater, installed new 110 cfm fan on timer switch.

Walk-through inspection findings 11-5-14:

- Lighting upgrades were performing as intended. Air sealing measures remained intact. Door seals were adequate. No mold spots visible on ceiling including ceiling of addition where 2" of rigid foam were installed under new plywood. We did however find some evidence of mold spotting on exterior wall near ventilation fan installed in 2009. This spotting did not appear to be actively growing and may have existed before '08-'09 retrofits. We also found older mold spotting near floor where things were stored against north-facing wall. Poor insulation levels in floor and exterior wall,

coupled with low airflow in that location and a single space heater with no heating distribution ducts would encourage mold growth even at normal indoor humidity levels.

- Ventilation fan installed in 2009 was found turned off. This fan control is designed to be left on so that timer switch may be operated with the dial switch as needed. I turned the fan control on again and checked the timer control that functioned. AEA staff provided a hygrometer during this site visit that we elected to install in this building on the fan cover plate to show occupants relative humidity levels and encourage use of the ventilation fan. Hygrometer readings just after the morning community meeting were around 34% RH. Approximately 45 people attended the meeting for 1.5 hours without driving relative humidity levels beyond 34%. (35% RH is considered an ideal level for good indoor air quality).
- The Monitor space heater installed in 2009 was heating building space as intended. Front cover housing had been removed however indicating servicing had been done or was on-going in some capacity.
- A blower door test was performed on this building with the following findings: Airflow at 50 Pascals building depressurization (CFM50) was 822. The post retrofit blower door test done in 2009 was 840 CFM50. The difference of 18 CFM50 is not significant and could be due to changes in building settling, or in using a different blower doorframe or a slightly different placement of the blower doorframe. Air changes per hour at 822 CFM50 are 4.2, which is not too tight concerning indoor air quality. The primary air leakage site identified during the blower door test was the junction, both floor and ceiling of the original building structure and the 12' x 48' building addition. Although these areas could receive additional air sealing to reduce heat-loss, if current conditions remain the same for this building I would recommend allowing this natural air infiltration to continue for indoor air quality concerns.

CITY OFFICE BUILDING

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures
- Air sealing, blown fiberglass insulation in attic, exterior door sweeps / seals, installed

Walk-through inspection findings 11-5-14:

- Lighting upgrades were performing as intended. Air sealing measures appeared intact, although in bathroom some of the original air sealing caulk was not installed properly (caulk beads were inconsistent and did not seal some corner and trim joints. Door seals were adequate. We saw no indication of problems with blown attic insulation. Indoor air quality was good with no indication of condensation forming on windows or windowsills. No other moisture issues were evident.

HEAD START BUILDING

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures
- Air sealing, blown fiberglass insulation in attic, exterior door sweeps / seals, installed programmable thermostat

Walk-through inspection findings 11-5-14:

- Lighting upgrades were performing as intended. Air sealing measures appeared intact. Door seals were adequate. We saw no indication of problems with blown attic insulation. Indoor air quality was good with no indication of condensation forming on windows. No other moisture issues were

evident. Programmable thermostat was no longer in service because a new Toyo stove had been installed to heat the building. Local resident Jane Tulik who runs the City Head Start program, said the building was much warmer and more comfortable than before, She thought less fuel was being used to heat the Head Start building.

PUBLIC SAVETY BUILDING

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures
- Air sealing, blown fiberglass insulation in attic, exterior door sweeps / seals

Walk-through inspection findings 11-5-14:

- Lighting upgrades were performing as intended. Air sealing measures appeared intact. Door seals on inside door were adequate, but outside door had sustained severe damage at the locksets and would no longer close. We saw no indication of problems with blown attic insulation. Indoor air quality was good with no indication of condensation forming on windows or window sills. No other moisture issues were evident. Heating note: Building was cold. Direct-vent space heater was in standby mode indicating no fuel. Also metal face-plate cover was removed from the space heater. However, lights were on and it appeared a staff person had recently been in the building working at their desk.

POST OFFICE

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures
- Air sealing, blown fiberglass insulation in attic, exterior door sweeps / seals, installed new Monitor direct vent space heater, modified interior walls and airflow vents for improved heating distribution

Walk-through inspection findings 11-5-14:

- Lighting upgrades were performing as intended. Air sealing measures appeared intact. Door seals were adequate considering the aged and warped condition of the main entry door. Since we did the energy retrofit work in '09, the building had settled some making it difficult to close the entry door properly against the seals. Even so, this was still a better condition then when we found it pre-retrofit. Currently, if one pushes the door firmly shut it was possible to make a good seal. We saw no indication of problems with blown attic insulation. Indoor air quality was good with no indication of condensation forming on windows or windowsills. No other moisture issues were evident. New Monitor space heater was functioning as intended. On-site staff said the building stayed nice and warm and that she knew of no problems with the building's performance.

WATER TREATMENT PLANT

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures.

Walk-through inspection 11-5-14:

- Our one-day site visit did not allow time to get to all buildings. As this building received only lighting upgrades only we elected to skip this building and focus our time on buildings that received both lighting and Wx measures.

- Also, since findings concerning lighting in all other buildings inspected showed the upgrades were performing well, I am confident this trend remains consistent for the Water Treatment Plant.

WARM STORAGE BUILDING

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures.

Walk-through inspection 11-5-14:

- Our one-day site visit did not allow time to get to all buildings. As this building received only lighting upgrades only we elected to skip this building and focus our time on buildings that received both lighting and Wx measures.
- Also, since findings concerning lighting in all other buildings inspected showed the upgrades were performing well, I am confident this trend remains consistent for the Warm Storage Building.

In general for the City, determining fuel savings from the WVR project for City buildings may be more challenging than for other entities, as there are more buildings to account for and a lot of staff turnover in the last 5 years. At the time of the WVR in '08 – '09, they had only an acting City Administrator at the time, Nick Tom, who moved from the village shortly after the retrofits were completed. The current City Administrator, Noah Laurence used to be the Traditional Council Administrator at the time of the original project. With all the staff and leadership turnover it may be difficult to acquire consistently maintained fuel use records.

Native Village of Nightmute Owned Building:

TRADITIONAL COUNCIL OFFICE BUILDING

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures
- Air sealing, exterior door sweeps / seals, blown fiberglass insulation in attic

Walk-through inspection findings 11-5-14:

- Lighting upgrades were performing as intended. Air sealing measures appeared intact. Door seals were adequate. We saw no indication of problems with blown attic insulation. Indoor air quality was good with no indication of condensation forming on windows or windowsills. No other moisture issues were evident.

Umkumuit Native Village Owned Building:

UMKUMUIT NATIVE VILLAGE OFFICE

This building retrofitted as part of the WVR no longer serves as UNV's office and is currently used for residential housing. Due to time constraints we were not able to assess the current UNV office located at the very far edge of the village away from the air strip.

WVR energy upgrades completed 2008 - 2009:

- Air sealing, blown fiberglass insulation in attic, exterior door sweeps / seals

Chinuruk Inc Owned Building:

CHINURUK CORPORATION STORE

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures
- Building foundation leveling and installed new metal roof for building viability (At Chinuruk expense for materials, shipping and labor), installed 2" rigid foam to building exterior and new siding, new plywood ceiling installed to allow air sealing, installed new insulated entry door, air sealing, blown fiberglass insulation in attic, exterior door sweeps / seals

Walk-through inspection findings 11-5-14:

- Lighting upgrades were performing as intended. Air sealing measures were mostly intact. Concerning door seals, we found the main insulated metal door that was installed in 2009 never had door-jamb seals and bottom sweep installed. I notified the store manager by email of this status and suggested seals and a door sweep be installed for added energy savings. We saw no indication of problems with blown attic insulation. Indoor air quality was good with no indication of condensation forming on windows or window sills. No other moisture issues were evident.
- A blower door test was performed on this building with the following findings: Airflow at 50 Pascals building depressurization (CFM50) was 1,685. Air changes per hour at 50 Pascals pressure was 7.0 ACH50, which indicates substantial current air leakage. The post retrofit blower door test done in 2009 was 1,272 CFM50. The difference of 413 CFM50 showed a fairly substantial increase (approx. 25%), in building air leakage in the 5 years since air sealing had been done.
- This finding reveals a potentially viable follow-up action to help air sealing measures remain viable, particularly in areas of the state that are known for building foundation movement: It could be economically favorable to revisit buildings that received air sealing and do blower door tests to determine new air leakage pathways and seal those areas. This could be done with one travelling contractor and a couple local hires from a given community. A pilot project could show numbers of buildings and changes in air leakage to determine projected cost savings of follow-up air sealing. Added mechanical ventilation may also be a needed follow-up program component associated with additional air sealing.
- Before the original energy retrofit projects, the old store's foundation was in very rough shape – requiring significant jacking and building leveling just prior to retrofits. Building settling after the foundation work is the most likely reason for the increase in air leakage. It was also noted the building owners had installed two fresh-80 passive air intake vents near their offices to increase ventilation primarily as a building cooling measure. Both vents were closed during the blower door test however and would not have contributed much to increased air leakage.
- In my follow-up email to store manager Jimmy George I also suggested sealing any areas where air leakage drafts could be felt. A primary air leakage site identified during the blower door test was the junction, mainly along the floor of the original building structure and the freezer area addition.

Some air leakage was also present in the far back of the building in the stock storage and honey bucket areas.

- In speaking with Jimmy George he was very happy with the results of the WVR energy upgrades. He said the retrofits really turned their building around and extended it's useful life. He was sure it used less fuel, but for actual fuel use records referred me to Kathy Kosbruk, Chinuruk's long-time bookkeeper who has been paying the fuel bills for many years. From the pre and post AKWarm runs done during the WVR project we were expecting a very substantial fuel savings of 74% annually. With a 25% increase in air leakage since the WVR however a more likely scenario might be around half the fuel cost pre to post retrofit. Jimmy George also said the staff feels safer in the building concerning indoor air quality. The old building with its leaky roof and bad foundation had mold and moisture issues which are no longer a problem since these structural issues were remedied (at Chinuruk Inc expense), but coordinated along with the energy retrofits in 2009.

Catholic Bishop of Northern Alaska Owned Buildings:

CATHOLIC CHURCH

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures
- Built drop ceiling in main hall and raised floor in attic to allow larger ceiling insulation cavity
- Air sealing, blown fiberglass insulation in attic, exterior door sweeps / seals, installed 7 triple-pane windows, installed R21 fiberglass bats and 2" rigid foam to formerly un-insulated floor, installed new Monitor direct vent space heater, installed new 110 cfm fan on timer switch. Also did some building foundation leveling and installed new metal roof for building viability (At CBNA's expense for materials, shipping and labor).

Walk-through inspection findings 11-5-14:

- Lighting upgrades were performing as intended. Air sealing measures remained intact other than attic hatch accessing east side attic storage area. Someone had broken the wood trim frame and cold air could be felt intruding into the building. This was brought to the church administrator's attention. Door seals were adequate. We saw no indication of problems with blown attic insulation. Indoor air quality was good with no indication of condensation forming on windows or windowsills. No other moisture issues were evident.
- A blower door test was performed on this building with the following findings: Airflow at 50 Pascals building depressurization (CFM50) was 489. Air changes per hour at 50 Pascals pressure was 2.3 ACH50. This is fairly tight, and warrants mechanical ventilation during periods when several people are in the building. The post-retrofit blower door test done in 2009 was 546 CFM50, which 2.55 ACH50. Originally I thought these numbers from 2009 were inaccurate and that the building could not be that tight. But as it turns out, with newer blower door equipment, the building envelop was actually tested as slightly tighter than in 2009. Nightmute Parish Administrator Jane Tulik said they always run the ventilation fan during services and that they never have any condensation or moisture issues.
- In speaking with Jane Tulik, she said she was very happy with the results of the program. She said they were using somewhere around half the fuel they used before the energy retrofits, and that was

for heating the building only part-time for services and community events. This is in alignment with the fuel savings expected from the upgrades. Pre and post AKWarm runs done during the WVR project predicted fuel savings of 68% annually for the church.

- Jane confirmed the WVR energy upgrades and the associated new roof did in fact save the historic Nightmute church built in 1946 or '47, from becoming unusable and being condemned. She was very pleased with how warm, useable and economical the building had become since the retrofits, stating that more people attend church now that it is a comfortable building.

CATHOLIC CHURCH HOUSING BUILDING

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures
- Air sealing, blown fiberglass insulation in attic, exterior door sweeps / seals,

Walk-through inspection 11-5-14:

- Again, our one-day site visit did not allow time to get to all buildings. I anticipate both the WX upgrades and lighting upgrades completed for this building still remain effective and consistent with findings for the other buildings inspected during our 5-year follow-up site visit.

Buildings Owned by the Lower Kuskokwim School District

NIGHTMUTE SCHOOL GYMNASIUM

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades (New T5 fluorescent fixtures)

NIGHTMUTE TEACHER HOUSING UNITS #: 17, 18, 19, 20

WVR energy upgrades completed 2008 - 2009:

- Lighting upgrades to linear fluorescent and screw-in bulb fixtures

Walk-through inspection 11-5-14:

- We ran out of time to get into teacher housing units. Since findings for lighting retrofits in all other buildings inspected showed the upgrades were performing well, I am confident this trend remains consistent for the LKSD Teacher Housing Units.

Conclusion:

In terms of the commercial / community building energy retrofits I was generally very happy with what we observed during our Nov 5th site visit. I believe the original program direction of concentrating efforts on the best payback measures attainable through working with local labor has paid off with favorable results. If attainable, I believe pre / post-retrofit fuel use records will affirm this.

Considering the rough shape of many commercial / community buildings in rural Alaska, considering the often times poor existing insulation levels, lack of maintenance budgets and Wx programs for rural Alaska

commercial / community buildings, there is enormous opportunity for substantial energy and cost savings at relatively little investment. This rural Alaska building sector offers low-hanging fruit one barely has to reach for. With the original retrofit work done in 2008 – 2009, we estimated the fuel and electrical savings payback periods would be substantially greater and faster than for residential energy retrofit projects which have enjoyed regularly funded programs for decades. From what I saw while inspecting the commercial / community buildings, I believe our original estimates for very favorable savings and payback ratios remain sound. Energy efficiency retrofits to existing commercial / community buildings in rural Alaska should remain an essential component for any WVR work and for building energy efficiency programs in Alaska moving forward.

Appendix B:

Nightmute Whole Village Retrofit Project - Follow-up Site Visit Residential Building Inspection Report

11-5-14

By Kent Banks, Director Wx RurAL CAP

Residential Wx Notes from Community Listening Session

The following commented on the Wx process for their residence:

1. John George (I inspected following this session) nails coming out of siding in some areas of the home where they must have missed the studs. There are some gaps in the insulation also.
2. Carl Mark (I inspected following this session) open area not insulated in the ceiling.
3. Mary Mathias (Not inspected) did not receive a fan and there was pre-existing rotten insulation in the walls by the windows which was not remediated prior to doing work in the home. "They said they would replace the insulation".
4. Simeon Agnus (I inspected following this session) kitchen light drips water.
5. Christopher George (not inspected) Roofing metal came loose on a windy day. He re-fastened. Nails are coming out on some of the siding on the home. "Nailings on the interior plywood are coming out in some places where they missed the truss".
6. Joseph Post (not inspected) nails coming out of the siding in some areas and off of the foundation posts.
7. Paul Joe (I inspected following this session) nails are coming out of the siding in some areas.
8. Stanley Anthony (I inspected following this session) ventilation? Air comes in around the windows. The living room windows are bad.

Post Inspection Notes:

In general, the Wx measures provided for Nightmute homes are continuing to provide for reduced energy burdens and better IAQ for the residents. Please refer to the nine home inspections that were performed on 11/5/2014 for more detailed information.

Note- The movement of the homes in Nightmute caused by natural springs under the homes and shifting rocks and soils is a factor in the failure of some of the nailing attachments for the exterior siding on the homes. It is recommended that following a siding re-attachment process for those homes requiring such which will be provided by RurAL CAP that the community perform attachment maintenance on an annual basis due to the constant shifting and movement of the homes.

2014 Residential Weatherization Survey - Where do things stand now, five years later?											
Survey #	Past Rural Cap empl.?	Notice reduction in utility costs for electricity since Wx?	Heating fuel reduction since Wx?	Primary and secondary heat?	More comfortable in home since Wx?	Status of ventilation?	Sign of moisture damage around windows?	Dryer vent cleaned? Working properly?	Use Hygrometer?	Wx improvements still working well?	Moisture in attic?
1	No	Yes	Yes	Heating Fuel/Toyo Stove	Yes	50 CFM fan installed and works well. Fresh 80 used in summer for cooling.	No	Cleaned 2x/year, working well.	No.	Yes.	N/A - attic hatch sealed during Wx, attic not used
2	No	No - stayed same	Yes	Oil/Wood	Yes	50 CFM fan in good condition. 3 x Fresh 80 in good condition	No.	Yes/yes.	No.	Yes.	N/A - attic hatch sealed during Wx, attic not used
3	No	Yes - a little	No	Wood/Oil	No	50CFM Fan was removed	No	No dryer vent used	No.	No, not happy with the improvements	Yes - attic hatch not sealed, homeowner complained of frost/moisture in attic
4	No	Yes - a little	No	Wood	Yes	50 CFM fan works okay, Fresh 80 in poor condition	No	No dryer vent used	No.	Yes.	N/A - attic hatch sealed during Wx, attic not used
5	Yes	No	Yes - a lot	Fuel oil and Toyo	Yes	50 CFM fan in good condition, one Fresh 80 in good condition	no answer	Yes/yes.	Have hygrometer but not using it	Yes.	Attic hatch not sealed, attic not used by resident, no moisture signs in attic
6	No	No - not much	Yes - a little	Oil/Wood	Yes	50 CFM fan in good condition. Fresh 80 in good condition but not used	No	Dryer vent not used	No.	Yes.	N/A - attic hatch sealed during Wx, attic not used
7	No	no answer	Yes	Oil/Wood	Yes	50 CFM fan in fair condition. Fresh 80 in good condition but not used.	no answer	Not working	Hygrometer broke	Yes.	N/A - attic hatch sealed during Wx, attic not used
8	No	No	No answer	Oil/Wood	No answer	50 CFM fan in good condition. Two Fresh 80s in good condition, used to relieve moisture problems.	Yes	Yes/yes.	Have hygrometer but not using it	no answer	Attic hatch not sealed, attic not used by resident, no answer about moisture in attic
9	No	no answer	Don't know	Oil/Wood	no answer	don't use fan because it's too noisy. No Fresh 80s	No	Not used	No.	no answer	Attic hatch sealed