



CCHRC

COLD CLIMATE HOUSING
RESEARCH CENTER

Weatherization Program IMPACTS REPORT

ALASKA STATE INVESTMENT

\$386.4 MILLION into the Weatherization Program has had the following effects:

STIMULATED

\$863.6
MILLION



in Direct, Indirect,
and Induced
economic impacts

The creation of
an estimated



5,460
annual jobs

\$319.9
MILLION



in health and safety
impacts

REDUCED

Total residential
energy costs* by

\$183
MILLION

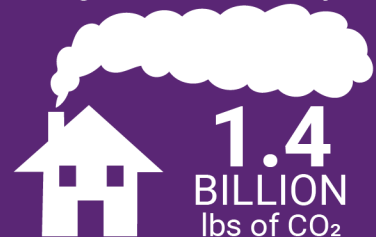


Total residential
energy use* by



47.4
MILLION
gallons of oil
(equivalent)

Alaska's greenhouse
gas emissions* by



1.4
BILLION
lbs of CO₂

Average energy use of
participating households by



* These reductions are cumulative estimates for the period of 2008 to 2018.

IMPROVED

Energy efficiency of



20,917
participating
homes

Average energy rating of
participating homes from



2-Star



3-Star

Indoor air quality and
comfort



leading to many reports
of better health and
quality of life

Weatherization Program IMPACTS REPORT

Oil prices spiked in 2007 and 2008, peaking at \$145.31 per barrel on July 3, 2008.¹ While this meant significant additional revenue for the State of Alaska, it also put a large energy cost burden on households, especially in communities where oil is the primary heating fuel and electricity is produced by diesel-fired generators. Alaska's cold climate leads to significantly higher energy use for home heating, with the average single-family home using approximately twice the energy per year as the average home in other "cold" climate regions of the U.S.² This high energy consumption and reliance on fuel oil leads to a higher energy cost burden for households throughout the state, particularly in rural regions where energy spending was as much as four times higher than the national average even with the relatively low oil prices of 2016.³

In response to this increased energy cost burden on households, the State of Alaska initially gave relief to Alaskans through a direct payment to everyone who was registered to receive a dividend in 2007. The Alaska Legislature provided longer-term relief to residents in 2008 by providing \$300 million in funding to expand the Alaska Housing Finance Corporation's (AHFC) Weatherization Assistance program and establish the Home Energy Rebate program. Success of the programs led to additional funding from the legislature for AHFC, totaling \$579 million from fiscal years 2008 to 2018.⁴

AHFC was directed to use these funds to meet the legislative intent of the programs. During testimony, legislative sponsors indicated program intent for home energy efficiency programs were to reduce

KEY OBJECTIVES

- Reduce residential energy use
- Reduce energy costs
- Create jobs and stimulate the construction industry
- Improve home comfort and durability
- Reduce greenhouse gas and particulate matter emissions
- Improve quality of home life and alleviate home residents hardship

home energy bills, create jobs, and increase affordability of home heating and electricity.⁵ To that end, AHFC administrators outlined six primary program objectives including reduce residential energy use, reduce energy costs, create jobs and stimulate the construction industry, improve home comfort and durability, reduce greenhouse gas and particulate matter emissions, and improve quality of home life and alleviate home resident hardship.⁶

This report evaluates the impacts of the Weatherization program on Alaska, focusing on the progress made between 2008 and early 2018 in each objective outlined in the legislative intent.

Program Description

The goal of the Weatherization program is "to increase the energy efficiency of dwellings owned

1. Cushing, OK spot price from U.S. Energy Information Administration. Data available at: https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm

2. Madden, D., Wiltse, N. 2018 Alaska Housing Assessment. CCHRC for Alaska Housing Finance Corporation. 2018. Available at: <https://www.ahfc.us/efficiency/research-information-center/alaska-housing-assessment/2018-housing-assessment>

3. Ibid.

4. In nominal dollars

5. Alaska State Senate Finance Committee testimony (2008, March 12). Retrieved on January 25, 2019: www.legis.state.ak.us/pdf/25/M/SFIN2008-03-121457.PDF

6. Personal communication with Research and Rural Development Staff, AHFC, 10/30/2018.



or occupied by low-income persons, reduce their total residential energy expenditures, and improve their health-and-safety, especially low-income persons who are particularly vulnerable such as the elderly, the handicapped, and children.”⁷ The Alaska Weatherization program strives to meet this goal by providing home-weatherization services to households based on income eligibility. Alaska’s Weatherization program began in 1976 funded by the State of Alaska and Federal Government, with the vast majority of funding between 2008 and 2018 coming from the State. The program uses designated weatherization service providers to perform weatherization services at no cost to qualified participants.⁸

The Weatherization program process starts when income eligible applicants apply with one of the weatherization service providers. If the applicant meets qualifying criteria, they are assigned a priority based on need. Weatherization service providers move through this list in order and schedule weatherization assessments. The weatherization service provider does an assessment of the home and creates a list of recommended energy efficiency, health, safety and repair measures. These measures are prioritized and performed based on program guidelines, assessment, performance testing, professional expertise, and experience.

In Alaska, two categories of weatherization exist: the Weatherization Assistance program and the Enhanced Weatherization program. The Weatherization Assistance program is for income-eligible participants that live on the road and marine highway system and the Enhanced Weatherization program is for all other regions of the state. Remote regions served by the Enhanced Weatherization program tend to be more expensive due to the high costs of transporting materials and personnel. To reflect these higher costs, the Enhanced Weatherization program allows an average expenditure of \$30,000 per housing

unit, whereas the average is \$11,000 per unit for the Weatherization Assistance program.⁹ This report refers to both of these programs collectively as simply the “Weatherization program.”

Program Participation

20,917 homes were retrofit from 2008 to 2018 at a total cost of approximately \$402.2 million. Overall, 59,190 people benefited from home retrofits through the Weatherization program between 2008 and

9. 2018 Weatherization Operations Manual. Alaska Housing Finance Corporation. Available at: <https://www.ahfc.us/application/files/6615/2850/2767/wom2018.pdf>

Inflation-adjusted dollars

All dollar amounts reported in this document are adjusted to 2018 values so that they can be compared to today’s dollars. This was done using either the consumer-price index or the IMPLAN software.

2018, or approximately 8% of Alaska’s population. The total residential building area retrofitted through the program was approximately 28 million square feet, even with the size of the average home served being approximately 1,000 square feet.

The target market for the Weatherization program is significantly different than the Home Energy Rebate program. The Weatherization program gives preference to lower-income families and/or those households supporting people who are elderly, people with disabilities, or children under six. The State of Alaska funding allowed the program to expand to cover households earning up to 100 percent of area median income for a given household size. This led to a large pool of potential participants, with an estimated 137,100 households that met program qualifications. Figure 1 shows the income brackets of households that participated in the Weatherization program versus the estimates of households that qualified for the program.

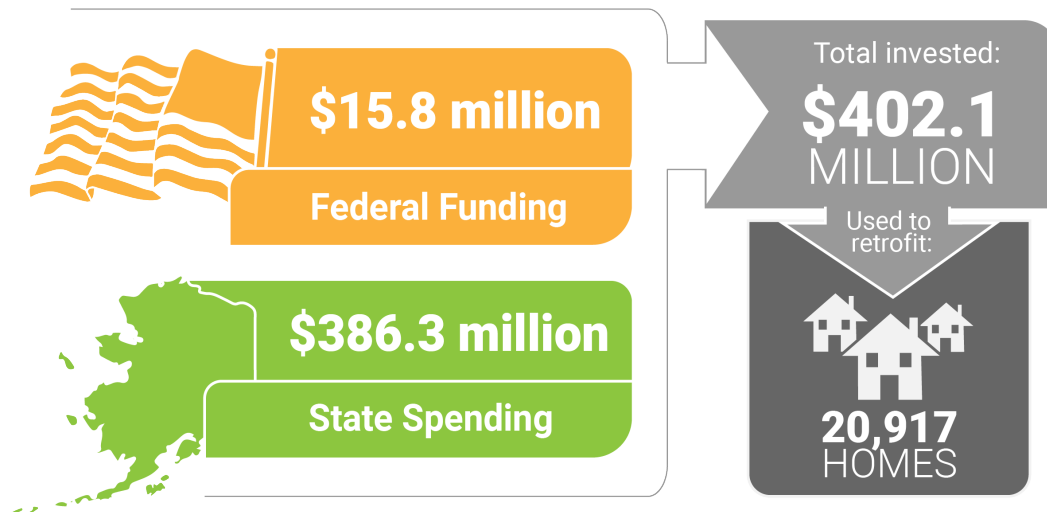
The estimate of households that qualified and were reasonably likely to participate was created by filtering out group quarters and unoccupied homes

7. Weatherization Assistance for Low-Income Persons. 42 U.S.C. §§ 6861 (b). Available at: <https://tinyurl.com/y8umcf22>

8. A current list of weatherization service providers can be found at <https://www.ahfc.us/efficiency/energy-programs/weatherization/weatherization-service-providers>



How much has been invested in the Weatherization Program between 2008 - 2018?



and then determining if the households qualified for weatherization services based on their income and number of people.¹⁰

Given that the total number of potential Weatherization program-eligible households is fairly high, the percent of the market that was reached between 2008 and 2018 is approximately 15 percent. Thus, while many homes have been retrofitted to be safer, healthier, and have less-burdensome energy costs, there is still a significant amount of work to be done, as is highlighted in Figure 1.

The Weatherization program served a high percentage of residents who live in rural areas, with approximately 42 percent of participating households being located outside of the urban centers.¹¹ Many of the participating households were Alaska Native, with 38 percent of households having at least one Alaska Native member.

Approximately 34 percent of participating households

10. Analysis used U.S. Census Bureau's Public Use Microdata Sample. "Group Quarters" is defined as "a place where people live or stay, in a group living arrangement, that is owned or managed by an entity or organization providing housing and/or services for the residents."

11. For the purposes of this report, "Urban" centers of the state are defined as those in the Anchorage, Mat-Su, Kenai Peninsula, Fairbanks North Star, or Juneau census areas. All other regions were considered "Rural" for this analysis.

included elderly members, and 24 percent had at least one child under the age of six. Documentation from the program also shows that approximately 14 percent of households had at least one person with a disability.

While the Weatherization program accepted applicants earning up to 100 percent of the area median income, the typical participant in the program made significantly less. In contrast, the median household income for households that participated in the program from 2008 to 2018 was \$28,263.

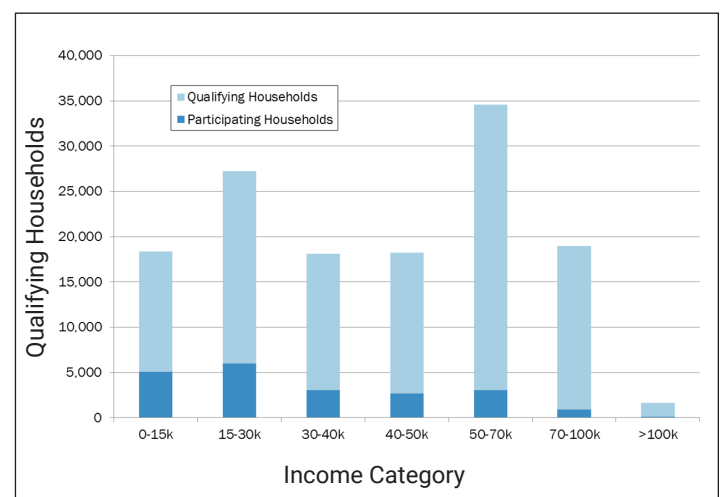


Figure 1: Households qualifying for Weatherization by income category



Energy Use Reduction

The Weatherization program has had a tremendous impact on residential energy consumption in Alaska. Our researchers estimate that annual residential energy usage has decreased by 1.3 trillion BTUs, equivalent to approximately 9.6 million gallons of fuel oil, as a direct result of energy efficiency measures. Figure 2 shows how the annual energy savings evolved over time. An estimated 6.4 trillion BTUs, equivalent to 47.4 million gallons of fuel oil, were saved over the 10 years.

With the energy efficiency retrofit measures having a savings-weighted average life of approximately 21 years,¹² the lasting impact of the Weatherization program would be the avoided consumption of a total of 27.5 trillion BTUs, equivalent to 202 million gallons of fuel oil.

To put the energy savings in context of an individual

12. The average life of energy efficiency measures used was weighted by the energy savings of the measures per home and then averaged across the records of all homes to arrive at an overall average energy efficiency measure estimated life.

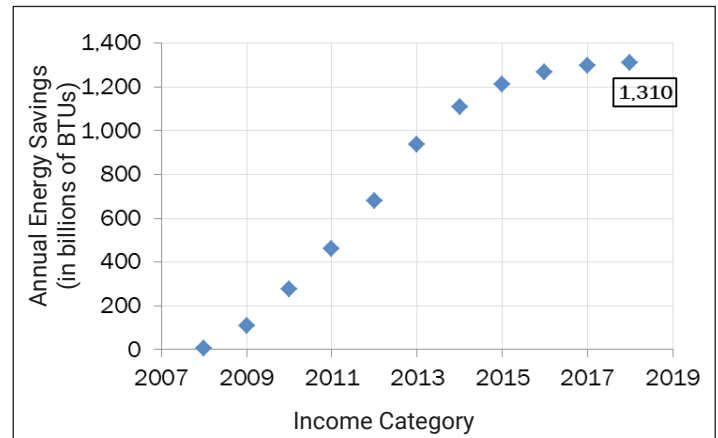
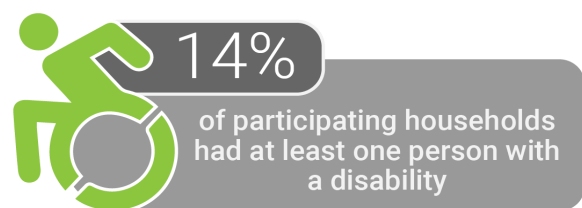
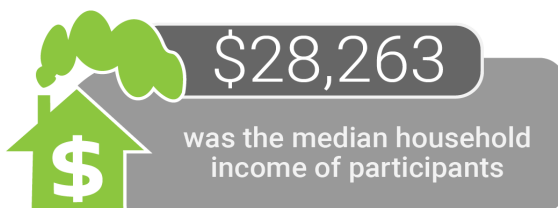
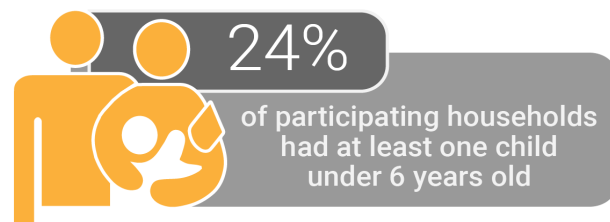
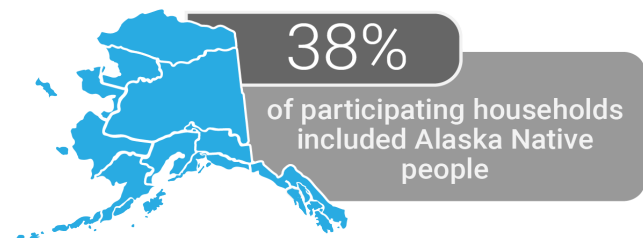
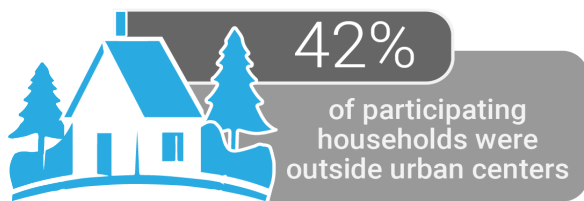


Figure 2: Annual energy savings from the Weatherization program

household, the average participating household prior to weatherization services consumed approximately 212.8 million BTUs, equivalent to 1,564 gallons of heating oil. Households that completed the program reduced their annual energy consumption to approximately 151.1 million BTUs, equivalent to 1,111 gallons of heating oil, for a savings of 61.7 million BTUs, or 453 gallon per year. This represents a 29

Who participated in the Weatherization Program between 2008 - 2018?





percent reduction in household energy consumption. The Calista region had the largest percentage reduction with participating households realizing a 42 percent energy use reduction on average. Participating households in the Ahtna, Chugach, and Doyon (outside of the Fairbanks North Star Borough) regions had the largest absolute reduction in energy, saving an average of 101.1 million BTUs or 740 gallons of heating oil equivalent per year.

A home's energy efficiency is often reported using its Energy Use Intensity (EUI). EUI is a measure of total annual energy used in a building per square foot of living space. Figure 3 highlights the range with the average 1-star home in the program using nearly five times the annual energy as a 5-star-plus home. Homes that were retrofit through the program improved by an average of 1-star.

Energy Cost Savings

The Weatherization program has impacted residential energy cost savings in Alaska. Our researchers estimate that annual residential energy costs have decreased by \$26.2 million as a direct result of energy efficiency measures. An estimated \$182.7 million in energy costs have been avoided since 2008.

Our researchers estimate that the energy-efficiency retrofit measures implemented have an average life of approximately 21 years. Using this metric, the impact of the Weatherization program will have a net present value of \$474.8 million in avoided energy costs, which is \$72.6 million more than the total program funding and does not include health-and-safety benefits.

To put the energy cost savings in the context of an individual, the average household at the start of the program paid \$5,503 in annual energy costs. Homes retrofit through the program reduced their annual energy costs to approximately \$4,237, a savings of \$1,266. This represents a 23 percent reduction in household energy costs. As different fuels have different costs, energy savings as a percent differs from energy cost savings. The Aleut and Bering Strait

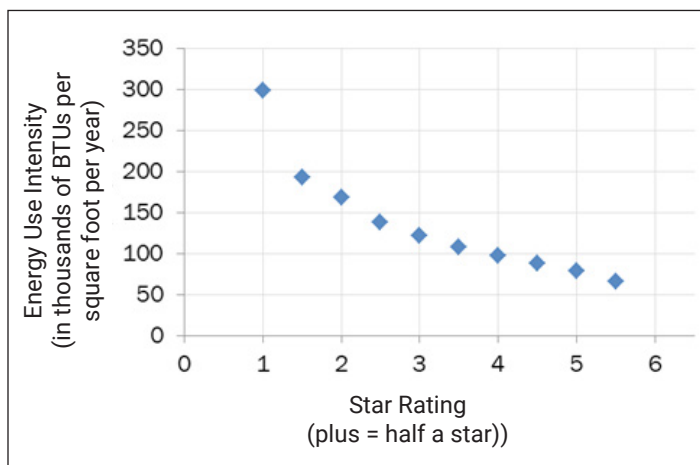


Figure 3: Average energy use intensity of homes in the Weatherization program by star rating

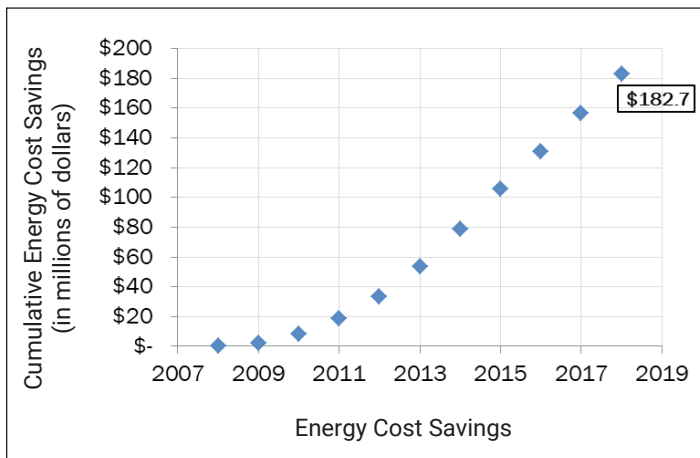


Figure 4: Cumulative energy cost savings from the Weatherization program

regions saw the largest percentage reduction with participating households experiencing an average 32 percent energy cost reduction. In general, rural areas and areas without access to natural gas saw the highest energy cost savings, with the Bering Strait, NANA, and Calista regions having the highest savings. Homes retrofit in the Bering Strait region saw the largest absolute energy cost reduction saving an average of \$2,441 per year.

Economic Impact

The Weatherization program had a demonstrable impact on the state economy. Our researchers



"One of the great hidden benefits of the program is the preservation of affordable housing stock throughout the state. It would be nice to replace older homes with new 5-6 star houses but that is not often a possibility given the overall cost of new construction, especially in remote rural areas of Alaska. Through the Weatherization program, thousands of homes have been upgraded to be more safe, healthy and efficient, which added years to the life of each building. In some cases, homes we improved forty years ago are some of the homes that we worked on in the past couple of years and will likely be there to serve that family for another generation."

– Mimi Burbage,
Energy Program Manager, Alaska Housing

estimate the total economic impact of the program from 2008 to 2018 has been \$863.6 million in 2018 dollars. This impact includes direct spending as well as indirect and induced effects.

Direct economic effects come from money spent by the State of Alaska and from Federal funding. From 2008 to 2018, \$386.3 million in state funding was spent on the program. The vast majority of that went directly to improving the energy efficiency and health-and-safety of homes. This money was leveraged by an additional \$15.8 million in Federal funds.¹³

The indirect effect on the economy is estimated at \$125.4 million dollars. Indirect effects are those on industries that supply goods and services to the sector directly affected. In this case, it includes impacts on businesses and people who supply materials to Weatherization providers, organizations that provide training to the retrofit industry, local insulation manufacturers, and more.

The induced effect from these funds circulating through the economy is an additional estimated

13. Annual Federal appropriations; does not include funds from the American Recovery and Reinvestment Act (ARRA)

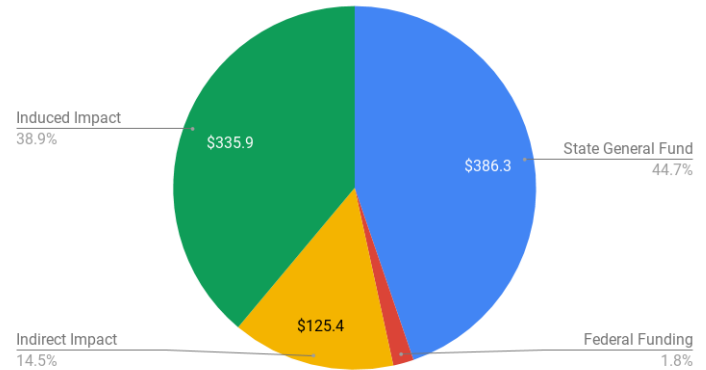


Figure 5: Total economic impact of the Weatherization program from 2008 to 2018 in millions of dollars

\$335.9 million between 2008 and 2018. Induced effects are effects on the economy from income earned by affected industries. In this case, there are two main induced effects: increased discretionary income available to households because they are now spending less money on energy each year, and increased income for those in the Weatherization industry from the retrofit spending.

The program also impacted jobs in the state. Input-output modeling estimated that 5,460 annual jobs were created over the life of the program.¹⁴ Many of these jobs are due to state spending and are thus temporary, but an estimated 167 permanent jobs were created due to the \$26.2 million in energy costs saved annually by households that participated. Induced job impacts are expected to continue over the life of the retrofit measures.

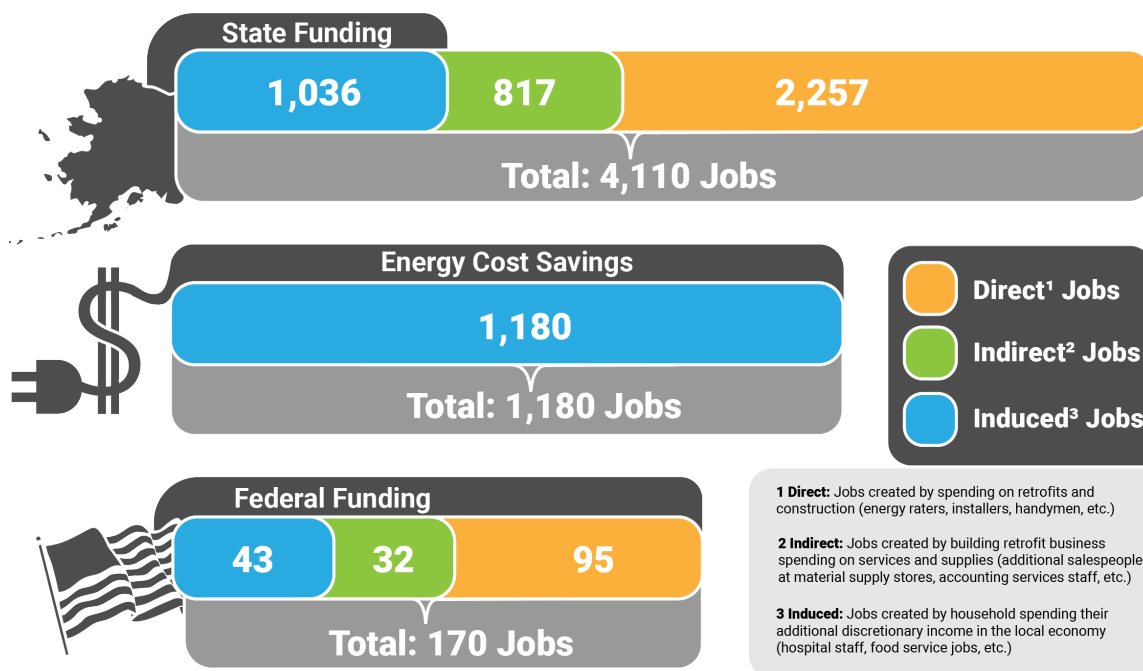
Cost-Effectiveness

The Weatherization program resulted in energy cost savings for households throughout the state. Total estimated energy cost savings from 2008 to 2018 for all 20,917 buildings retrofit is \$182.7 million dollars, with an additional \$26.2 million saved annually. The impact of the Weatherization program will have a net present value of \$474.8 million

14. An annual job is defined as one job for one year in the IMPLAN input/output economic modeling; consequently, if one person worked for five years doing retrofits, it would be counted as five annual jobs. This is the same definition used by the U.S. Bureau of Labor Statistics and Bureau of Economic Analysis.



5,460 annual jobs have been created by the Weatherization Program between 2008 - 2018.



in avoided energy costs over the life of the retrofit measures. Weatherization program guidelines require that certain health-and-safety measures be completed. For Alaska an average of 21 percent of program spending was used to improve the health and safety of homes. Focusing on just the energy-efficiency measures, approximately \$317.7 million was spent. Comparing the costs and benefits of the energy-efficiency measures shows that the societal cost-effectiveness of the Weatherization program provides a return on investment estimated at 8 percent. This estimate does not consider either the costs or benefits of health-and-safety measures.

Health and Safety Cost-Effectiveness

Nationally, the economic benefits of health-and-safety measures performed through the Weatherization program are estimated at nearly three times higher than the benefits from energy-efficiency measures.¹⁵ The Oak Ridge National Laboratory estimates the

present value of health-and-safety benefits from participating in the Weatherization program is \$14,148 per single family home in the U.S., or \$15,295 in 2018 dollars.¹⁶ Assuming this holds true in Alaska, the total present value to society of the health-and-safety measures implemented would be approximately \$319.9 million. It should be noted that these estimated health-and-safety benefits are based on a national average and not Alaska-specific numbers, and are not included in estimates of overall impact of the program. Consequently, the total economic impact and the number of jobs created by the program are likely underestimates.

There are several reasons to believe that the Weatherization program's health-and-safety benefits to Alaska are even higher than the national average. Alaska has the highest healthcare costs in the nation, spending on average \$11,000 per resident for healthcare as compared to the national average of \$8,000.¹⁷ This suggests that the same number of avoided health procedures would have a higher

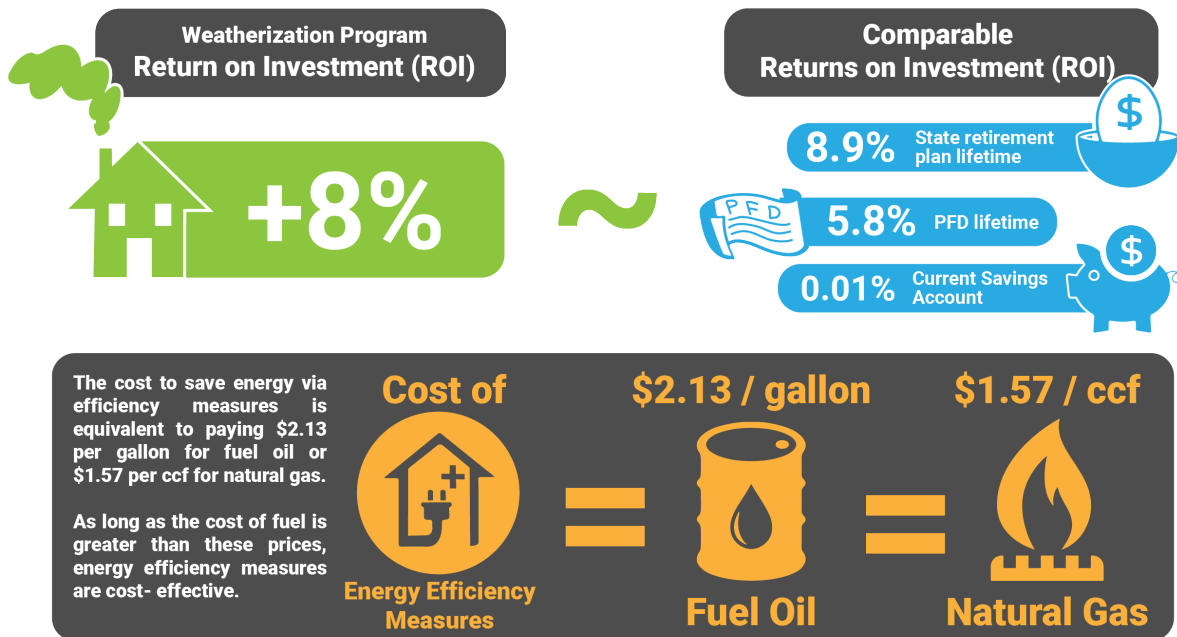
15. Tonn, B. et. al. (2014). *WEATHERIZATION WORKS – SUMMARY OF FINDINGS FROM THE RETROSPECTIVE EVALUATION OF THE U.S. DEPARTMENT OF ENERGY'S WEATHERIZATION ASSISTANCE PROGRAM*. Oak Ridge National Laboratory. Available at: https://weatherization.ornl.gov/wp-content/uploads/pdf/WAPRetroEvalFinalReports/ORNL_TM-2014_338.pdf

16. Ibid.

17. Passini, J., Frazier, R., Guettabi, M. (2018). *Trends in Alaska's Health-Care Spending*. UAA Institute for Social and Economic Research.



What has been the cost-effectiveness of the Weatherization Program between 2008 - 2018?



monetary value associated with them. In addition, the amount of funding available for health-and-safety measures is also higher in Alaska than the national average due to additional state funding allocated to the program between 2008 and 2018. This suggests more health-and-safety measures could have been implemented. Finally, a significant amount of the weatherization work was done in rural Alaska where hospitalization requires a medivac and very high rates of childhood lower respiratory tract infections exist,¹⁸ which can be caused by poor indoor air quality and may be alleviated by weatherization work. For example, the Alaska Native Tribal Health Consortium (ANTHC) conducted an indoor-air-quality intervention in Southwest Alaska that included retrofits similar to those implemented by the Weatherization program, including changing out woodstoves and installing mechanical ventilation systems. These interventions reduced lower respiratory tract infection visits in children by approximately 33 percent; the direct medical cost of a hospitalization alone is estimated

A life-cycle cost analysis of the program shows a savings-to-investment ratio of 1.5.

at more than \$22,000.¹⁹

Levelized cost of saved energy

Another way to consider the cost-effectiveness of the Weatherization program is to compare costs of producing these energy savings to the cost of using fossil fuels. This can be done by calculating the levelized cost of saved energy to the energy-efficiency program as a whole. "Levelized" in this case means that initial costs of the energy efficiency programs are spread over the life of the energy savings. This is the best way to compare the cost of saving energy to the cost of producing new energy.

Using the total annual energy savings and the total costs of the program including administrative overhead, the estimated levelized cost of saved

Available at: <https://iseralaska.org/publications/?id=1718>

18. Peck, AJ, Holamn, RC et. al. (2005). *Lower respiratory tract infections among American Indian and Alaska Native children and the general population of U.S. Children*. The Pediatric Infectious Disease Journal. Apr;24(4):342-51

19. Singleton, R. et. al. (2018). Impact of home remediation and household education on indoor air quality, respiratory visits and symptoms in Alaska Native children. International Journal of Circumpolar Health. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5804775/#CIT0023>.



energy is at \$15.69 per million BTUs.²⁰ The cost of saving energy through efficiency is equivalent to paying \$2.13 per gallon of fuel oil or \$1.57 per ccf of natural gas. Given that a high percentage of these retrofits were done in rural Alaska where natural gas is not available and fuel oil prices are much higher than urban areas, this cost of saving energy is relatively inexpensive.

A life-cycle cost analysis of the program shows a savings-to-investment ratio of 1.5.²¹ This means the energy cost savings from the program will earn back the money spent on installing the efficiency measures plus 50 percent in today's dollars over the course of their useful life.

Home Efficiency

The Weatherization program had a positive impact on the housing quality of participating households.

20. Using fuel escalation rates and a discount rate from "Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis. National Institute of Standards and Technology. U.S. Department of Commerce. Available at: <https://nvlpubs.nist.gov/nistpubs/ir/2018/NIST.IR.85-3273-33.pdf>"

21. Ibid.

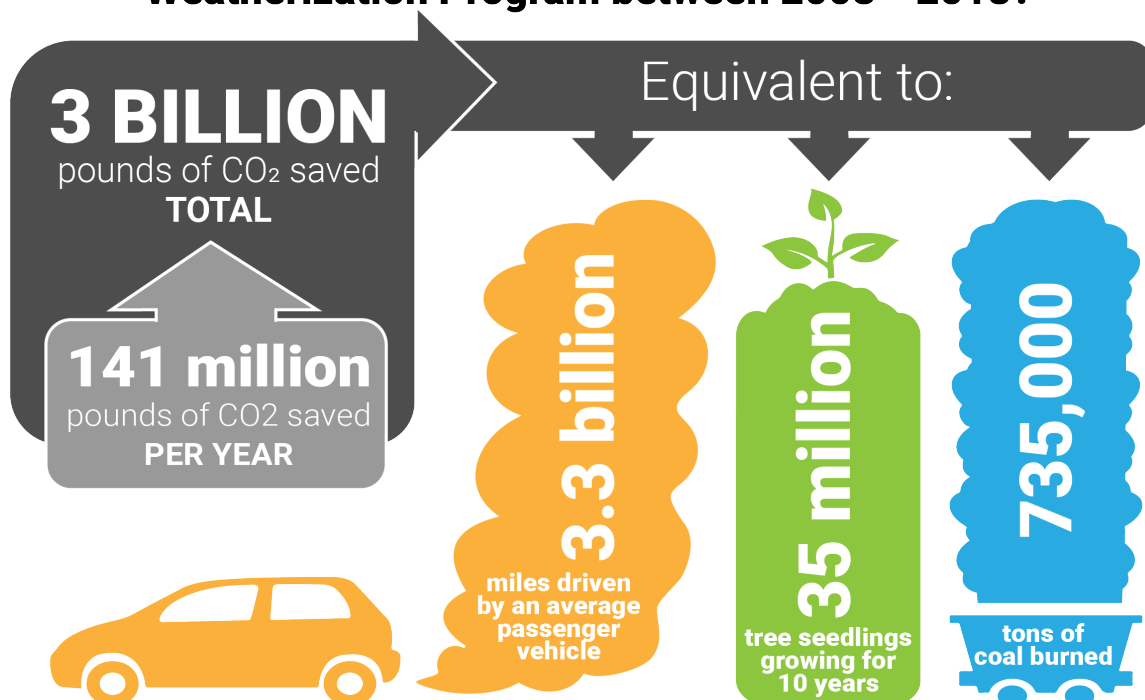
The average home entering the program was energy rated as 2-star. Homes that were retrofit averaged a 3-star. Average homes in some regions had higher starting and finishing points. For example, the Aleut region saw average improvements from 3-star to 4-star-plus. The NANA and Bering Strait regions saw the largest improvement from 2-star to 4-star.

Reducing Environmental Impact

The U.S. Energy Information Administration reports that the building sector is responsible for approximately 36 percent of the U.S.'s greenhouse gas emissions.²² AkWarm energy modeling software was used to calculate that the average home entering the Weatherization program produced approximately 32,390 pounds of the greenhouse gas carbon dioxide (CO₂) per year. As a result of the energy-efficiency measures, homes reduced carbon dioxide emissions by an estimated 6,740 pounds per year, a 21 percent reduction.

22. U.S. Energy-Related Carbon Dioxide Emissions, 2017. U.S. Energy Information Administration. Available at: <https://www.eia.gov/environment/emissions/carbon/>

How many pounds of CO₂ emissions have been saved by the Weatherization Program between 2008 - 2018?





Interior Alaska saw homes with the greatest carbon dioxide emissions entering the program with an average of 51,650 pounds in the Fairbanks North Star Borough. Participating households in the Arctic Slope region saw the largest absolute reduction with energy efficiency measures reducing 12,020 pounds of carbon dioxide per home per year on average. The Aleut and Bering Strait regions saw the largest percentage carbon dioxide reduction at 30 percent and 29 percent respectively.

Overall, the Weatherization program reduced residential carbon dioxide emissions by approximately 141 million pounds per year and is expected to avoid approximately three billion pounds of carbon dioxide emissions over the life of the energy efficiency measures.

Key Stakeholder Interviews

Cold Climate Housing Research Center (CCHRC) conducted interviews with more than 50 key stakeholders to obtain qualitative data on the impacts of the Weatherization and Home Energy Rebate programs. Interviewees included Weatherization providers, energy raters, builders, suppliers, and others in the construction and retrofit industries. The following sections on Improvements to Quality of Life and Impact on Industries are largely based on this qualitative data, with quantitative data added where available.

Improvements to Quality of Life

A desired outcome of the program was to improve quality of home life and alleviate hardships. Interviews with key stakeholders highlighted the ways the Weatherization program accomplished this.

Health and safety benefits

AHFC's Weatherization Operations Manual outlines its policy toward health-and-safety: "Weatherization implements mandatory health-and-safety measures

"This was one of the most successful programs executed in the region to improve people's living conditions."

—John Santos,
Aleutian Housing Authority

as well as weatherization-related health-and-safety measures that are necessary to install energy-efficiency measures, to provide a safe workplace, and/or to protect clients." AHFC emphasizes installing necessary health-and-safety measures but when using Federal funds grantees are required to not exceed 20 percent of the average cost per unit on these measures.²³ State funding can be used for health and safety measures exceeding that cost, but an analysis of the data shows that this is relatively rare.

The median percent of weatherization funds spent on health-and-safety measures was approximately 15 percent, and the average was 21 percent. This suggests that a few outlier homes had significantly more funding dedicated to health-and-safety; Mike Carlson of AHFC confirmed there are some cases

23. 2018 Weatherization Operations Manual. Alaska Housing Finance Corporation. Available at: <https://www.ahfc.us/efficiency/research-information-center/manuals-forms-and-workbooks/weatherization-operations-manual>

Mandatory Health and Safety Measures in Weatherization

Every home that receives weatherization retrofit measures also receives an inspection and corrections for mandatory health and safety equipment, including:

1. Smoke Detectors
2. Carbon Monoxide Detectors
3. Combustion safety check
4. A whole house ventilation fan
5. A range hood fan over a gas combustion range



where, due to serious health-and-safety deficiencies, the homes require a much higher percentage of funding go to those measures.

Carbon monoxide mitigation

A potential danger in homes is carbon monoxide. This colorless, odorless gas is produced during combustion of fuels and can enter homes through problems with heating and ventilation systems or if vehicles are idling in attached garages. Weatherization assessors are trained to identify and test for presence of this gas. Carbon Monoxide can lead to significant health impacts at low levels and death at higher concentrations. They are required to test for and correct combustion safety failures.

Interviews with key stakeholders uncovered many accounts of dramatic health and life saving benefits. Weatherization providers tell of children and others with asthma and breathing problems, persistent coughs, headaches and fainting spells that were resolved by fixing back-drafting appliance and ventilation issues.

"One house had soot all over the walls from a bad range hookup. I showed the high CO reading on oven preheat to the wife and she said "maybe that's why the girls were passing out". That didn't happen any more after the problem was fixed."

—Dennis McGlothlin,

Based on discussions during interviews, it is likely that installation of smoke and carbon monoxide detectors and the discovery of hazards during inspection also saved lives.

"Several chimneys were found to be disconnected in attics and corrected... it was amazing the houses hadn't caught fire!"

—Jim Lee,
Interior Weatherization

Air-Tightness, Ventilation & Indoor Air Quality

On average, people spend an estimated 87 percent of their time indoors, which makes fresh, clean air important for health and quality of life.¹ Indoor air pollutants are estimated to cause damage to human health that is in the range of damage caused by motor vehicle accidents and heart disease.²

Historically, air entered homes primarily through leaky construction. Air leaks not only cause homes to be drafty and uncomfortable, but they also increase energy costs and allow moisture to penetrate into the structure of the home, reducing building durability. Uncontrolled air leakage also allowed air from crawl spaces, garages, and other pollutant-rich areas to enter the home. Modern homes are built to be relatively air-tight and then have a controlled amount of fresh air introduced into the building using a mechanical ventilation system. Interviews with energy raters and other stakeholders highlighted the improvements to indoor air quality from retrofitting homes to be more air-tight and to add in mechanical ventilation systems.

¹ Klepeis, NE, et al. (2001). The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pollutants. <https://www.ncbi.nlm.nih.gov/pubmed/11477521>. 2001 May-Jun;11(3):231-52.

² Logue, J. M., Price, P. N., Sherman, M. H., & Singer, B. C. (2012). A method to estimate the chronic health impact of air pollutants in U.S. residences. *Environmental Health Perspectives*, 120, 2, 216-22.

Indoor air quality improvement

In addition to fixing combustion safety issues, the Weatherization program specifically addresses indoor air quality. Weatherization providers are required to install a whole-house ventilation fan in



every home as well as a range hood if there is a gas combustion range installed. Considering an estimated 56 percent of all occupied homes statewide are at risk for moisture and air-quality related issues due to inadequate ventilation,²⁴ this requirement has likely improved indoor-air quality significantly throughout Alaska. According to weatherization staff, mechanical ventilation is a priority and is installed whenever possible; data from the program verified that approximately 10,600 of the homes involved in the program, which had no mechanical ventilation before, had new mechanical ventilation systems installed. This is expected to lead to improved indoor air quality in those homes.

Comfort and quality of life benefits

Participant surveys showed that weatherization participants were more comfortable after program work and were very likely to recommend the program to friends. Asked, “Are you more comfortable after weatherization work?” on a scale of 1 to 5 (5 being highest agreement), the average score was 4.3, with approximately 60 percent providing a score of 5. More than 90 percent of respondents said they would recommend the program to friends.

In interviews with Alaskan weatherization providers, effects on participants’ lives included many reports of increased comfort and warmth. These ranged from kids that are now able to go barefoot indoors because the floors are not freezing to families being able to live in their whole house in the winter, not just one heated room.

The impact on people’s lives was also evident in the spontaneous feedback and reactions observed by weatherization providers. People wrote “thank you” notes. People cried in happiness at how much lower their bills were. Dennis McGlothin of Copper River Basin Regional Housing Authority was surprised by a hug from a stranger on the street who said his house was so much warmer.

24. Madden, D., Wiltse, N. 2018 Alaska Housing Assessment. CCHRC for Alaska Housing Finance Corporation. 2018. Available at: <https://www.ahfc.us/efficiency/research-information-center/alaska-housing-assessment/2018-housing-assessment>

Draft reduction

The majority of homes retrofit through the Weatherization program had their air leakage reduced, which would make the houses less drafty. On average, homes retrofit in the program reduced air leakage by approximately 34 percent, likely leading to significantly improved comfort.

Impact on Industries

Weatherization providers

In interviews with eleven weatherization providers, peak employment during the period of increased funding was three to twelve times higher, with an average of about seven times higher, than current employment. Providers that did weatherization before 2008 are back down to approximately pre-increased-funding levels of employment. For many of the regional housing authorities, there was no weatherization program before 2008.

Impact of increased funding

The steep increase in funding led to requirements for more office, storage, and workshop space, more tools, more employees, more local hires, more vehicles, and more computers. There was also more money allocated to each home served, which allowed for more complete retrofits as well as assisting more homes in more communities. The additional funding helped with the providers’ administrative costs as their organizations grew to accommodate the workload. The additional weatherization funding also spurred some housing authorities to bring energy-efficiency considerations into all other programs they operated, and blower-door tests and indoor-air quality checks are now done routinely for projects.

During the period of increased weatherization funding, providers were able to train more staff and attend inter-agency meetings, which helped spread knowledge widely across providers and increased overall competency. Providers saw financial efficiencies of scale in transporting materials to communities. Standardized training, check-lists, and reporting documents as per AHFC requirements were developed.



During the period of increased funding, there were increased opportunities for training, and training was available on a wider selection of relevant topics. Further, the training opportunities were brought to more employees of weatherization providers and crew-members. An employee could learn essential skills more quickly with all the opportunities. During the funding increase between 2008 and 2016, personnel had access to numerous training and networking opportunities that allowed personnel to interact with and learn from national experts. All this training has led to a more skilled construction workforce. It has bled over into new home construction for the Housing Authorities. Local hires and others that worked in weatherization take the knowledge of energy efficiency and building science to other construction work. More skilled construction labor is available in communities because of this.

Impact of decreased funding

The main effects of the rapid decrease in funding were the need to lay off people and the resulting loss of morale that it caused in existing employees. Interviewees reported that it has been difficult to hire new people in weatherization when they are needed because it is not seen as a dependable career field. Further, it has been harder to ensure crews have year-round work. Fewer homes are served in fewer communities resulting in reduced economies of scale. Fixed administrative costs have to be covered by other program funding. While essential training still exists, it is not as robust as it was during the period of increased funding.

Heating contractors and suppliers

The Home Energy Rebate and Weatherization programs increased demand in the market for new heating and domestic hot water equipment, especially for higher efficiency appliances. In interviews with nine heating contractors and suppliers across Alaska, almost everyone noted an increase in sales, especially in Anchorage, Fairbanks, and with those who already sold or installed high-efficiency equipment. Ferguson Supply of Anchorage reported the programs increased monthly sales and Moore Heating reported their business grew by about a

"Once you learn it, you always have it"

–John Santos,
Aleutian Housing Authority

"There is more of a knowledge base, a better building culture. Building science is more understood."

–Jim Lee,
Interior Weatherization

"There is more skilled labor and knowledgeable homeowners and clients."

–Kimberly Carlo,
Interior Regional Housing Authority

quarter.

Contractors and suppliers generally report an industry shift to high-efficiency and sealed combustion/direct vent appliances, which was an impact to the building industry proffered by the Weatherization program. While some natural draft heating appliances are still sold, most contractors have switched to federally approved direct vent devices.

Suppliers

Suppliers with established weatherization-related programs or organization partnerships experienced market changes.

Market changes were largely in the form of sales volume. Demand for existing products increased

It changed the whole market, even for new homes. We seldom now sell anything less than 95% efficient; 90% or more of our sales are high efficiency equipment. There is always a learning curve on controls, etc. for the contractor. With the old equipment, you could do anything wrong and it would still run. But this was good for contractors too – gives them work to keep it running efficiently.

–Drew Clay,
Ferguson Anchorage Branch Manager



or decreased with program funding. The decrease in program funding has resulted in sales losses, predominantly in terms of sales volume of weatherization-related products.

Conclusions

Overall, the Weatherization program demonstrated economic and environmental impacts to the State of Alaska that are expected to continue. The \$386.3 million in state funding spent on the program between 2008 and 2018 resulted in increased efficiency of homes, improved quality of life for many households, and contributed to the evolution of Alaska's building

industry. The program helped households who were the least likely to have the resources to implement energy-efficiency measures and who will likely benefit the most from lower energy costs and improved health-and-safety.

These impacts will continue to benefit the state over the life of the energy efficiency measures. The health-and-safety measures, education benefits and updated industry norms will also likely continue to positively impact homeowners and the construction industry into the future.

KEY ACCOMPLISHMENTS

Over the course of 10 years, the Weatherization program cumulatively:

- Reduced residential energy use by The energy equivalent of 47.4 million gallons of fuel oil
- Reduced Alaskans' residential energy costs by \$183 million
- Provided an economic stimulus to the economy of an estimated \$863.6 million including direct, indirect, and induced impacts
- Retrofit approximately 15 percent of its potential market in the past 10 years
- Improved the indoor air quality and comfort for many homes, which led to reports of better health and quality of life
- Created an estimated 5,460 annual jobs
- Improved the energy efficiency of 20,917 homes, on average moving them from a 2-star energy rating to a 3-star energy rating, representing a 29 percent reduction in energy use
- Reduced greenhouse gas emissions throughout the state by 1.4 billion pounds of CO₂
- Likely provided at least \$319.9 million in societal benefits from health and safety improvements above the economic stimulus of the energy