ACES-AK Technical Appendix

ACES-AK Program Region

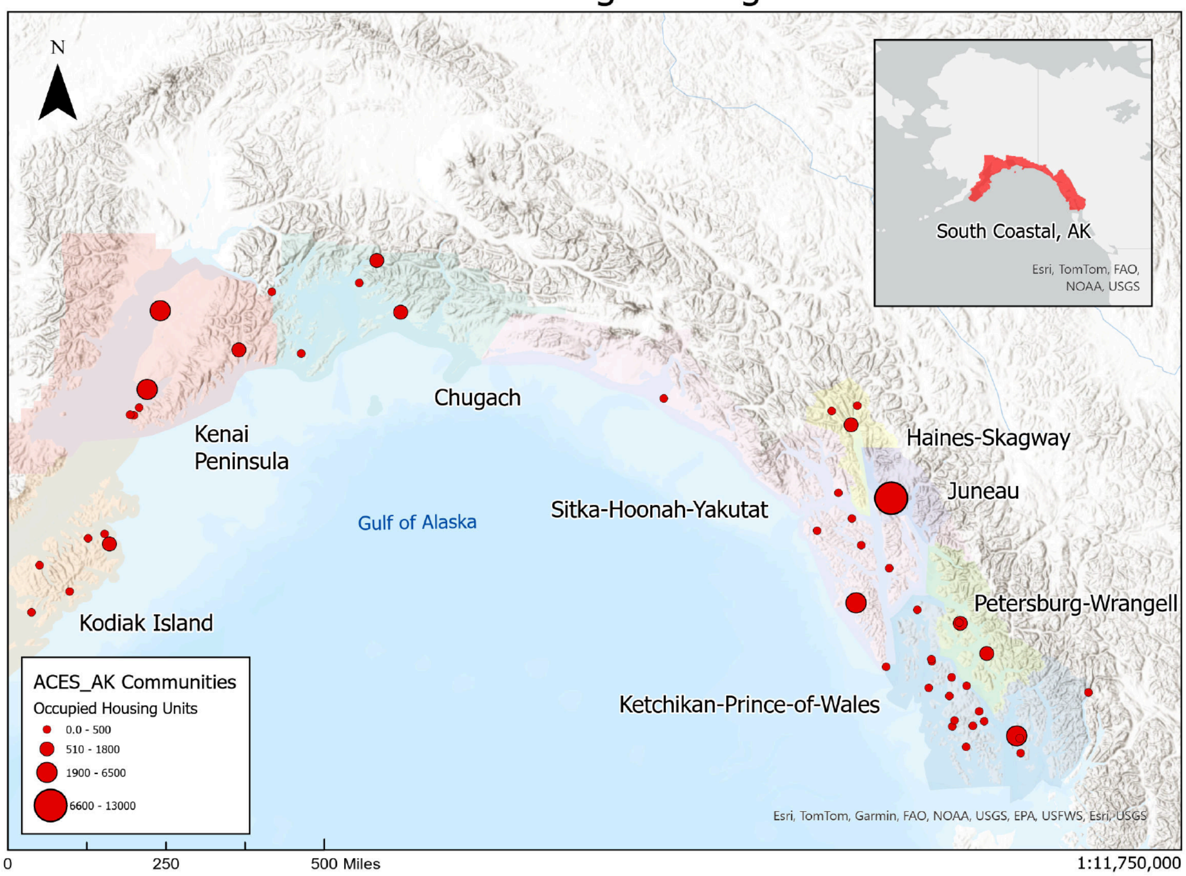

Figure TA.1

A. GHG Reduction Estimate Method

The method for estimating GHG reduction for the ACES-AK program involved the following major steps.

1. Assessing the heat pump adoption potential in each subregion community and setting heat pump installation targets for each subregion.
2. Calculating the GHG emission reductions from the target heat pump installations numbers.
3. Comparing with a GHG emissions reference case.

These steps, methods and assumptions are discussed below.

1. Assessing community potential and setting incentive targets

Gulf of Alaska communities are diverse and dispersed, ranging from a few hundred residents to Alaska's capital city, Juneau, with a population of 31,000. Many are isolated, without road connections, and they have widely varying systems for electricity generation, and different heating and electricity costs. However, they share a high reliance on oil for space heating.

Key factors influencing household uptake of heat pumps in the region were identified. Data from various sources, including demographics, current heating systems, quality of housing, fuel and electricity costs, electric generation sources, and access to heat pump contractors, were compiled for each of the 50 communities (see GHG emissions reduction spreadsheet for details). Additionally, interviews and discussions with local experts and project advisors were conducted across the region. These insights helped assess the barriers to adoption and the overall potential for heat pump uptake in each community.

Communities were grouped into subregions based on their heat pump adoption potential and each Subregion was assigned a specific target for increasing heat pump installations. These targets informed program incentives.

a. Subregions with a high potential for heat pump adoption have 100% renewable/hydroelectricity, low electric rates, high cost savings from heat pumps, high availability of installers, a larger population size/consumer base allowing for cost-effective delivery of advisory services and heat pump installations, or easy access to these hub communities. These are expected to have relatively rapid rates of heat pump uptake. These were assigned a target of a 30% increase in heat pump installations over the 5 year program.

b. Subregions of mid level potential for heat pump adoption include communities with a mix of generation sources, moderate costs for electricity, and middle levels of savings from heat pump installations. These include smaller communities without local heat pump installers. Some are in the process of developing renewable, particularly hydro, energy sources. These were assigned a target of a 25% increase in heat pumps over the 5 year program.

c. The subregion of lowest near-term heat pump adoption potential includes the communities in the southern Kenai Peninsula with a colder winter climate, lower proportions of renewables in the electric generation mix, higher electric rates, a large proportion of houses heating with less expensive natural gas, little community experience with heat pumps, and fewer or no local heat pump installers. This area is expected to have the slowest rate of uptake of heat pump incentives, and was assigned a target of 15%.

However, this region is important as a springboard for long-term uptake of heat pumps to reduce fossil fuel space heating in Alaska's population center, the greater Anchorage area, 200 miles to the north. Rising natural gas prices and increases in renewable electricity generation are expected to make heat pumps more attractive in this area in the longer term[1]; the ACES -AK program will contribute to setting the stage for accelerating this shift by developing consumer experience with heat pumps and supporting installer businesses.

Table TA.1 summarizes subregion heat pump adoption potential and incentive targets. More details can be seen in the GHG Emissions Reduction spreadsheet.

Table TA.1 Subregions and targets

Subregion	Population	# of occupied houses heated with oil	5 year potential for heat pump adoption & project targets	# of heat pumps and incentives
Kodiak	5,999	1,454	High 30%	437
Kenai	9,286	6,051	Low 15%	908
Chugach	6,753	2,386	Med. 25%	597
Sitka-Hoonah-Yakutat	11,126	2,514	Med. 25%	629
Haines-Skagway	2,111	513	High 30%	154
Juneau	31,700	8,124	High 30%	2443
Petersburg-Wrangell	4,879	787	Med. 25%	237
Ketchikan-Prince of Wales	13,612	2,087	Med. 25%	702
Project Region Total	85,456	24,653	-	6107

2. Calculating GHG emission reductions

[1] https://www.uaf.edu/acep/projects/railbelt-decarbonization.php

GHG emission reductions resulting from the installation of a heat pump were calculated for each community using Analysis North's Alaska Heat Pump Calculator (AHPC)[2]. The AHPC is designed to evaluate the possible energy and cost savings from use of a ductless heat pump in a specific Alaskan home or small building. It provides default values for a number of key variables for each community, including heat loss, electric utility rates, fuel prices, and GHG emissions coefficients for various types of fuels. It also provides a range of customizable inputs including building size, condition, and occupant usage affecting energy use .[3] The following procedure outlines how the AHPC was used in GHG emissions reduction calculations:

a. Census housing data informed assumptions of the characteristics of an average house (outlined in Table TA.2) for each community, which were used as inputs to the calculator.
b. Calculations were run twice for each community to account for the massive disparity in heating energy consumption across the range of housing energy efficiency. The first run assumed an older house with low energy efficiency (constructed pre-1980, 2x4 wall, R11 insulation, drafty, and never retrofitted). The second run assumed a house of more modern (post 1980) standard construction, reasonably air tight, with a 2x6 wall and R19 insulation. The proportion of each of these types of houses in each area, estimated from regional housing data,[4] was used to weight the average GHG emissions reduction per heat pump installation in each community (see attached GHG Emissions Reduction spreadsheet for more details).
c. The average GHG emissions reductions per heat pump for each community were averaged by subregion and weighted by the number of oil-heated households in each community.
d. The average GHG emissions reduction per heat pump in each subregion was multiplied by the target number of heat pump adoptions for that subregion to calculate the annual GHG emission reduction for each subregion.
e. Annual GHG emissions reductions were totalled based on target heat pump install schedule (detailed in the GHG emissions reduction spreadsheet) for the 2025-2030 GHG emissions reduction figure, and the 2025-2030 figure was added to '20' times the total annual GHG emissions reductions for the 2025-2050 GHG emissions reduction figure.

3. Key Assumptions and inputs into AHP Calculator

This section describes the basic assumptions built into the Analysis North Alaska Heat Pump Calculator (AHPC), and their application to our analysis. Further detail can be found in the calculator documentation.[5]

[2] https://heatpump.analysisnorth.com/
[3] Mini-Split Heat Pumps in Alaska: Heat Pump Calculator Algorithms and Data
[4] https://www.ahfc.us/pros/energy/alaska-housing-assessment/2018-housing-assessment
[5] Mini-Split Heat Pumps in Alaska: Heat Pump Calculator Algorithms and Data

Heat pump type. Calculations were based on the AHPCs default inputs for a simple single head minisplit ductless heat pump, with an *HSPF of* 14.0 and *Maximum Heat Output at 5 °F:* 16,500 BTUs per hour. With recent improvements in cold climate heat pumps these are conservative figures.

Alaska Heat Smart has evaluated over 500 Juneau homes to provide advice on heat pump installations, and has gained experience with a wide range of building and heating system configurations. For the purpose of this project, and for calculating GHG reduction, we assume that most installations will be of ductless heat pumps involving a single indoor unit located in the main living space of the home.

This aligns with experience from similar programs elsewhere. In Efficiency Maine's large Ductless Heat Pump retrofit program, 85% of the retrofit installations involved one indoor unit. The ACES-AK program will not be restricted to these equipment types, but additional incentives will not be provided for larger or more complex installations. The AHPC's assumed efficiency for ductless heat pumps is based on older models and is conservative. Variations in types and configurations of heat pumps that are actually installed as a result of the ACES - AK program are not expected to reduce estimated oil or GHG emission reductions.

Heat pump efficiency. An average annual COP is calculated from a model incorporating temperature and performance curves that combine manufacturer HSPF adjusted by Alaska performance measures. These typically range from about 2.6 to 2.8 across the region. Typical Meteorological Year climate data was used to drive an hourly heat loss model of the building.

Heat Loss. The AHPC estimates the building's heat loss coefficient from the count of garage stalls, the square footage of the floor area of the home, and the type of wall insulation, which is used as a proxy for the overall thermal shell quality. Our project's inputs to the calculator for floor area and type of wall insulation are discussed in more detail below.

Heat Distribution Model. The calculator incorporates a simple thermal model that allows adjustments for how much of the house a heat pump is expected to heat, and what proportion of the space heating load it will provide. For the ACES-AK analysis, we assumed a single head mini split in a main living space; inputs included the default of 45% of the house's directly exposed to the heat pump, doors regularly kept open to adjacent rooms, and a high tolerance for lower temperature (10 degree difference) in bedrooms.

Fossil Fuel emission factor. The AHPC uses the following coefficients for each type of fuel:

- #1 Oil - 137,452 BTU/gallon - 161.3 lbsCO2/MBTU
- Natural Gas - 103,700 BTU/ccf - 117.0 lbsCO2/MBTU

Table TA.2 Input Assumptions to the AHPC

Home heating and energy factors	**Assumptions for GHG Calculations**
Utility Rate	Local Residential Utility Rate
Building Type	Residential
Building Floor Area (Square Feet)	Census Region Average
Size of Garage	No Garage
Wall Construction (Factor of insulation efficiency)	2x4 - % of low energy efficiency housing (Drafty, 1980 construction & not retrofitted) 2x6 - % of standard & high efficiency housing
Existing Space Heating Fuel Type	#1 Oil (most consistent available data)
Fuel Price Per Unit	Community's $/gal rate of #1 Oil
Efficiency of Existing Heating System	80% Efficiency
Auxiliary electricity use	Standard Forced Air Furnace Fan
Heat Pump Type	Singe Zone
Installed Cost of Heat Pump	0$
Heat Pump is Turned Off below this Outdoor Temperature	-10 F (Modern Cold Climate Heat Pumps still effective at temperatures below -13)
Percentage of the Home that is Openly Exposed to the Heat Pump Indoor Units	46%; average based on AHPC default and corroborated by AHS home assessments.
Tolerance for Cooler Bedroom and Back Room Temperatures	Bedrooms can be as much as 10 degrees Cooler than Main Spaces
Are Doors typically open to the Bedrooms and Back rooms that do not have a Heat Pump Indoor Unit?	Open Doors
Sales Tax	Community Specific Sales Tax

Electricity Emission Factor. Electricity - 3413 BTU/kWh; the AHPC provides a specific factor for each electric utility, drawing from the statewide AkWarm database which recently updated the Pounds of CO2 / kWh used for each electric utility in the state. The emissions factor is based on the entire generation fuel mix of each utility. The pounds-CO2 / kWh is also applied to the heat pump electricity consumption to offset a portion of the CO2 reduction resulting from saving fuel oil. Across the region these range from 100% hydro, to mixes of diesel and hydro, to larger, more efficient diesel generators, smaller less efficient diesel generators, and mixed natural gas and hydro.

Models/Tools Used

The basic modeling tool used to develop the GHG emission reduction estimate was the Analysis North Alaska Mini-split Heat Pump Calculator (AHPC).[6] This web-based calculator was developed primarily by Alan Mitchell (Analysis North) to estimate the performance and financial return of installing a mini-split heat pump in a home in Alaska. Community-specific climate, fuel cost, and electric utility rate information is available in the calculator for most communities in Alaska.[7]

These data are drawn from the same database used by the AKWarm energy modeling tool, developed by the Alaska Housing Finance Corporation (AHFC) for use in energy design, retrofits, and certified audits, including showing compliance with Alaska Housing's Building Energy Efficiency Standard (BEES).[8] Alaska Heat Smart has compared the results of the AHPC to its own energy use assessments for more than 500 Juneau homes, and finds a close correspondence between modeled and measured results.

Measure Implementation Assumptions

- Assumed rate of measure implementation: See Section A.1. above.
- Implementation milestones: See Section 3C **Work Plan and Timeline.**
- Average annual household reduction in oil usage from adding a heat pump: 546.6 gallons.
- Heat pump equipment lifetime: 14 years.
- Capital cost assumption: average heat pump cost, installed, including electric: $8500

GHG Reduction Estimate Assumptions

The AHPC uses a variety of inputs (see Table TA.2) to determine how much energy in MBTUs it takes to heat the home. We assumed #1 oil heating at 80% efficiency to heat a home of a certain square footage. The calculator's heat pump model uses the inputs to calculate an efficiency of the heat pump which in turn it uses to calculate how much energy the heat pump needs to heat the home. With that number (in MBTU) it uses electricity generation source and efficiency data for the specific mix of generation sources for each utility, and applies the emissions factors to calculate the emissions from electricity. Then it subtracts those emissions from the emissions saved.

[6] https://heatpump.analysisnorth.com/
[7] https://analysisnorth.com/pages/projects.html
[8] https://www.ahfc.us/efficiency/pro-builders/akwarm-energy-rating-software

The Calculator also considers the electricity use of the oil heating system (fans/pumps/controls), and accounts for the GHG emissions associated with that electricity. The GHG associated with electricity use is based on the particular electric utility selected. The AkWarm project recently updated the Pounds of CO_2 / kWh used for each electric utility in the state, and those are the figures used in the Heat Pump Calculator. The emissions factor is based on the entire generation fuel mix of each utility. The pounds-CO_2 / kWh is also applied to the heat pump electricity consumption to offset a portion of the CO_2 reduction resulting from saving fuel oil.

The AHP Calculator uses the following factors:

- Electricity - 3413 BTU/kWh; adjusted by the calculator for different generation mixes.
- #1 Oil - 137,452 BTU/gallon - 161.3 lbsCO_2/MBTU
- Natural Gas - 103,700 BTU/ccf - 117.0 lbsCO_2/MBTU

Reference Case Scenario (BAU)

ACES - AK calculations of GHG reductions are based on the assumption that CPRG measures are additive to a reference case, which is the amount of oil burned for space heating that will be reduced by a typical heat pump installation. Calculations show this to be 546.6 gallons per house annually.

Little information is available about current levels or rates of heat pump installations for most communities in the project region, but given the barriers to heat pump adoption identified in Sections 1 and 2, including lack of information and trust in the technology as well as upfront costs, it is reasonable to assume that in the absence of this ACES - AK Program, conversions from oil heat to heat pumps through 2030 would continue at a slow pace for the region as a whole.

Current non-CPRG incentives for heat pumps are modest compared to those proposed by ACES - AK. Several small electric utilities are providing $500 rebates for heat pumps, with low levels of uptake. The 30% tax credit for heat pumps is projected to perform similarly, since in order to benefit from it homeowners have to come up with up-front payments. While there does exist a diversity of partial funding incentives to help with heat pump purchases as documented in the project narrative in Section 1, most if not all are not sizable enough to propel a homeowner to action.

Both our BAU and CPRG program scenarios assume a relatively constant ratio between electricity rates and oil prices over the project period. Electricity rates are assumed to stay relatively constant, but oil prices are likely to be more volatile. If oil prices were to drop significantly, uptake of incentives and heat pumps might be somewhat slower, although most residents are very aware of oil's potential volatility, particularly in the face of recent substantial increases. If oil prices were to climb, rates of heat pump uptake are likely to increase, as occurred in Juneau with double digit oil price increases in winter 2023.

Measure-Specific Activity Data

See Inputs to Alaska Heat Pump Calculator Table T.A.2

- Air-source heat pumps installed in houses currently heated primarily by oil: 6,107
- Annual reduction in oil usage for the average house: 546.6 gallons

B. GHG Emissions Reduced

The ACES-AK program of heat pump incentivization in coastal Alaska communities is projected to result in the following total reductions in GHG emissions:

1. **Annual GHG emission reductions:**
   a. 2025 through 2030:

Year	2025	2026	2027	2028	2029	
Annual Reductions MTCO2e resulting from each year's measures	3871	9400	16,607	22,694	27,680	

   b. 2030 through 2050: 27,680 MTCO2e

2. **Cumulative GHG emission reductions**
   a. 2025 through 2030: 80,253 MTCO2e
   b. 2025 through 2050: 633,858.30 MTCO2e

C. GHG Emission Reduction Spreadsheet (spreadsheet attached)

All information in this technical appendix, as well as in Section 2 of the full project narrative, came from data pulled from the GHG Emission Reduction Spreadsheet and its five tabs: Community Breakdown, Region Breakdown, Subregion Breakdown, GHG Calculations, and Documentation.

- The **Community Breakdown** sheet includes data per community that fuels the Subregion breakdown calculations of emissions reductions. Where data was unavailable at the community level, data for the community's census area (compiled in the Region Breakdown sheet) was used.
- The **Region Breakdown** sheet includes data on the census area regions that the communities fall within. This data is used to supplement community data as described above.
- The **Subregion Breakdown** sheet compiles subregion average fuel savings and emissions reductions per installation, and the incentives and cost breakdown for installations.
- The **GHG Calculations** sheet compiles the target heat pump installation numbers with the project timeline, to calculate the total GHG emissions reduction potential for 2025-2030 and 2025-2050, as well as program cost effectiveness.
- The **Documentation** sheet outlines what each column in the sheets is and the data source or calculation explanation.

									Average Housing Data									Alaska Heat Pump Calculator Data: Low Efficiency Homes			Alaska Heat Pump Calculator Data: Standard/High Efficiency Homes						
Name	Region	Sub-Region	Fossil Fuel Electricity Generation (%)	Renewable Energy Electricity Generation (%)	Electricity Price ($/kWh)	Oil 1 Price ($)	Population	% of total CPRG focus region population	Housing Units	Occupied Housing Units	Average House sq.	% Homes built before 1980 & not retrofitted	% Homes Classified as Drafty	% Low Energy Efficient Homes	% Standard/High Energy Efficient Homes	% Homes Fossil Fuel Heat	Estimate # Homes Fossil Fuel Heat	Annual Heating Fuel Savings (gal)	Annual Increase in Electricity Usage (kWh)	Annual GHG Emissions Savings (lbCO2)	Annual Heating Fuel Savings (gal)	Annual Increase in Electricity Usage (kWh)	Annual GHG Emissions Savings (lbCO2)	Efficiency-weighted Heating Fuel Savings (gal)	Efficiency-weighted Annual GHG (MTCO2)	Heating Fuel Savings * Occupied Housing Units	Annual GHG * Occupied Housing Units
Kodiak	Kodiak Island Borough	Kodiak Island	0%	100%	0.19	5.26	5,420.00	5.82%	2,130.00	1,770.00	1,854.00	39%	53%	46%	54%	73%	1,295	671.00	7,195.00	14,879.00	491.00	5,311.00	10,882.00	573.38	5.77	1,014,880.10	10,205.34
Port Lions	Kodiak Island Borough	Kodiak Island	0%	100%	0.19	3.99	168.00	0.18%	122.00	66.00	1,854.00	39%	53%	46%	54%	73%	48	671.00	7,195.00	14,879.00	491.00	5,311.00	10,882.00	573.38	5.77	37,842.99	380.54
Juneau	Juneau Cit and Borough	Juneau	0%	100%	0.12	4.55	31,700.00	34.05%	14,100.00	13,000.00	1,841.00	29%	58%	43%	57%	63%	8,142	644.00	7,204.00	14,271.00	480.00	5,475.00	10,651.00	551.07	5.54	7,163,863.00	72,055.62
Larsen Bay	Kodiak Island Borough	Kodiak Island	0%	100%	0.50	3.97	33.00	0.04%	83.00	18.00	1,854.00	39%	53%	46%	54%	73%	13	671.00	7,195.00	13,440.00	491.00	5,311.00	9,820.00	573.38	5.21	10,320.81	93.70
Petersburg	Petersburg Borough	Petersburg-Wrangell	0%	100%	0.13	4.25	2,790.00	3.00%	1,480.00	1,230.00	1,750.00	39%	67%	53%	47%	41%	506	615.00	6,781.00	12,964.00	455.00	5,100.00	9,580.00	540.08	5.16	664,292.75	6,348.74
Kupreanof	Petersburg Borough	Petersburg-Wrangell	0%	100%	0.13	4.97	19.00	0.02%	23.00	5.00	1,750.00	39%	67%	53%	47%	41%	2	615.00	6,781.00	12,964.00	455.00	5,100.00	9,580.00	540.08	5.16	2,700.38	25.81
Wrangell	Wrangell Borough	Petersburg-Wrangell	0%	100%	0.15	4.71	2,070.00	2.22%	1,350.00	928.00	1,800.00	37%	66%	52%	48%	30%	279	605.00	6,552.00	12,752.00	444.00	4,882.00	9,359.00	527.13	5.04	489,172.53	4,676.92
Ketchikan	Ketchikan Gateway Borough	Ketchikan-Prince of Wales	0%	100%	0.11	4.71	8,070.00	8.67%	3,930.00	3,290.00	1,778.00	33%	74%	54%	46%	55%	1,808	584.00	6,447.00	12,309.00	432.00	4,858.00	9,101.00	513.52	4.91	1,689,469.87	16,149.01
Saxman	Ketchikan Gateway Borough	Ketchikan-Prince of Wales	0%	100%	0.11	4.71	380.00	0.41%	140.00	118.00	1,778.00	33%	74%	54%	46%	55%	65	584.00	6,447.00	12,309.00	432.00	4,858.00	9,101.00	513.52	4.91	60,594.97	579.20
Sitka	Sitka Borough	Sitka-Hoonah-Yakutat	0%	100%	0.17	4.71	8,380.00	9.00%	4,140.00	3,460.00	1,689.00	35%	57%	46%	54%	55%	1,894	570.00	6,116.00	12,636.00	413.00	4,483.00	9,155.00	485.36	4.88	1,679,337.32	16,885.97
Haines	Haines Borough	Haines-Skagway	11%	89%	0.26	4.71	1,370.00	1.47%	826.00	615.00	1,751.00	20%	54%	37%	63%	46%	281	597.00	6734.00	12564.00	447.00	5,158.00	9399.00	502.34	4.79	308,939.71	2,947.68
Skagway	Skagway Borough	Haines-Skagway	16%	84%	0.26	4.71	741.00	0.80%	538.00	346.00	1,689.00	31%	58%	45%	55%	67%	231	579.00	6,544.00	11,531.00	433.00	5,003.00	8,602.00	498.01	4.49	172,312.39	1,554.72
Valdez	Chugach Census Area	Chugach	38%	62%	0.36	4.70	3,870.00	4.16%	1,930.00	1,660.00	1,838.00	35%	54%	44%	56%	87%	1,447	724.00	8,053.00	11,210.00	534.00	5,995.00	8,246.00	618.31	4.34	1,026,391.15	7,199.23
Cordova	Chugach Census Area	Chugach	22%	78%	0.28	4.71	2,510.00	2.70%	1,110.00	883.00	1,838.00	35%	54%	44%	56%	87%	770	690.00	7,814.00	10,600.00	523.00	6,052.00	7,972.00	597.10	4.14	527,241.26	3,660.01
Seward	Kenai Peninsula Borough	Kenai Peninsula	79%	21%	0.20	5.13	2,850.00	3.06%	1,230.00	1,020.00	2,006.00	30%	28%	29%	71%	79%	807	751.00	8,404.00	9,917.00	573.00	6,533.00	7,479.00	624.67	3.71	637,167.64	3,787.72
Whittier	Chugach Census Area	Chugach	79%	21%	0.21		265.00	0.28%	347.00	155.00	1,838.00	35%	54%	44%	56%	87%	135	715.00	8,072.00	9,385.00	543.00	6,239.00	7,043.00	619.32	3.67	95,994.73	568.23
Gustavus	Hoonah-Angoon Census Area	Sitka-Hoonah-Yakutat	17%	83%	0.27	4.42	620.00	0.67%	503.00	248.00	1,260.00	35%	68%	51%	49%	53%	132	472.00	5,317.00	8,877.00	347.00	3,957.00	6,498.00	411.20	3.50	101,978.37	868.42
Coffman Cove	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	6%	94%	0.30	5.50	125.00	0.13%	205.00	82.00	1,258.00	31%	77%	54%	46%	44%	36	432.00	4,722.00	8,641.00	313.00	3,456.00	6,252.00	376.98	3.42	30,912.67	280.32
Craig	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	6%	94%	0.30	6.19	1,020.00	1.10%	589.00	489.00	1,258.00	31%	77%	54%	46%	44%	214	397.00	4,230.00	7,961.00	284.00	3,054.00	5,695.00	344.76	3.14	168,586.54	1,533.43
Hollis	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	6%	94%	0.26	5.79	138.00	0.15%	83.00	83.00	1,258.00	31%	77%	54%	46%	44%	36	397.00	4,230.00	7,961.00	284.00	3,054.00	5,695.00	344.76	3.14	28,614.89	260.28
Hydaburg	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	6%	94%	0.27	4.20	374.00	0.40%	150.00	125.00	1,258.00	31%	77%	54%	46%	44%	55	397.00	4,230.00	7,961.00	284.00	3,054.00	5,695.00	344.76	3.14	43,094.72	391.98
Kasaan	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	6%	94%	0.26	4.89	28.00	0.03%	39.00	32.00	1,258.00	31%	77%	54%	46%	44%	14	397.00	4,230.00	7,961.00	284.00	3,054.00	5,695.00	344.76	3.14	11,032.25	100.35
Klawock	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	6%	94%	0.30	5.49	705.00	0.76%	382.00	312.00	1,258.00	31%	77%	54%	46%	44%	137	397.00	4,230.00	7,961.00	284.00	3,054.00	5,695.00	344.76	3.14	107,564.42	978.39
Naukati	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	6%	94%	0.30	6.00	120.00	0.13%	58.00	52.00	1,258.00	31%	77%	54%	46%	44%	23	397.00	4,230.00	7,961.00	284.00	3,054.00	5,695.00	344.76	3.14	17,927.40	163.06
Thorne Bay	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	6%	94%	0.30	5.26	466.00	0.50%	330.00	227.00	1,258.00	31%	77%	54%	46%	44%	99	397.00	4,230.00	7,961.00	284.00	3,054.00	5,695.00	344.76	3.14	78,260.01	711.84
Edna Bay	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	100%	0%		5.17	25.00	0.03%	36.00	16.00	1,258.00	31%	77%	54%	46%	44%	7	397.00	4,230.00	7,961.00	284.00	3,054.00	5,695.00	344.76	3.14	5,516.12	50.17
Hyder	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	100%	0%		5.56	16.00	0.02%	59.00	16.00	1,258.00	31%	77%	54%	46%	44%	7	397.00	4,230.00	7,961.00	284.00	3,054.00	5,695.00	344.76	3.14	5,516.12	50.17
Homer	Kenai Peninsula Borough	Kenai Peninsula	83%	17%	0.28	5.44	5,880.00	6.32%	2,940.00	6,462.00	2,006.00	30%	28%	29%	71%	79%	5,119	758.00	8,740.00	8,059.00	591.00	6,977.00	6,125.00	639.48	3.03	4,132,324.99	19,598.73
Port Graham	Kenai Peninsula Borough	Kenai Peninsula	83%	17%	0.26	4.85	142.00	0.15%	74.00	45.00	2,006.00	30%	28%	29%	71%	79%	36	758.00	8,740.00	8,059.00	591.00	6,977.00	6,125.00	639.48	3.03	28,776.64	136.48
Seldovia	Kenai Peninsula Borough	Kenai Peninsula	83%	17%	0.26	7.36	242.00	0.26%	189.00	88.00	2,006.00	30%	28%	29%	71%	79%	70	758.00	8,740.00	8,059.00	591.00	6,977.00	6,125.00	639.48	3.03	56,274.31	266.90
Nanwalek	Kenai Peninsula Borough	Kenai Peninsula	83%	17%		5.57	172.00	0.18%	57.00	38.00	2,006.00	30%	28%	29%	71%	79%	30	758.00	8,740.00	8,059.00	591.00	6,977.00	6,125.00	639.48	3.03	24,300.27	115.25
Metlakatla	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	6%	94%	0.09	5.35	1,440.00	1.55%	486.00	443.00	1,258.00	31%	77%	54%	46%	44%	194	361.00	3,645.00	7,270.00	254.00	2,582.00	5,114.00	311.53	2.85	138,008.53	1,260.55
Pelican	Hoonah-Angoon Census Area	Sitka-Hoonah-Yakutat	76%	24%	0.25	5.35	92.00	0.10%	75.00	36.00	1,260.00	35%	68%	51%	49%	53%	19	479.00	5,447.00	4,091.00	350.00	4,021.00	2,946.00	416.26	1.60	14,985.27	57.71
Kake	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	76%	24%	0.55	4.75	533.00	0.57%	254.00	172.00	1,258.00	31%	77%	54%	46%	44%	75	448.00	4,920.00	3,035.00	324.00	3,599.00	2,155.00	390.67	1.19	67,195.62	205.04
Angoon	Hoonah-Angoon Census Area	Sitka-Hoonah-Yakutat	76%	24%	0.30	4.77	339.00	0.36%	266.00	162.00	1,260.00	35%	68%	51%	49%	53%	86	430.00	4,679.00	3,051.00	308.00	3,346.00	2,148.00	370.66	1.18	60,047.28	191.92
Hoonah	Hoonah-Angoon Census Area	Sitka-Hoonah-Yakutat	76%	24%	0.50	8.09	951.00	1.02%	364.00	269.00	1,260.00	35%	68%	51%	49%	53%	143	479.00	5,447.00	3,001.00	350.00	4,021.00	2,142.00	416.26	1.17	111,973.50	315.19
Klukwan	Hoonah-Angoon Census Area	Sitka-Hoonah-Yakutat	76%	24%		5.00	67.00	0.07%	54.00	30.00	1,260.00	35%	68%	51%	49%	53%	16	448.00	5,127.00	2,249.00	330.00	3,844.00	1,928.00	390.61	1.07	11,718.23	31.97
Old Harbor	Kodiak Island Borough	Kodiak Island	100%	0%	0.64	5.56	210.00	0.23%	128.00	75.00	1,854.00	39%	53%	46%	54%	73%	55	671.00	7,195.00	2,648.00	491.00	5,311.00	1,854.00	573.38	1.01	43,003.59	75.45
Ouzinkie	Kodiak Island Borough	Kodiak Island	100%	0%	0.52	5.44	103.00	0.11%	68.00	40.00	1,854.00	39%	53%	46%	54%	73%	29	671.00	7,195.00	2,648.00	491.00	5,311.00	1,854.00	573.38	1.01	22,935.14	40.23
Akhiok	Kodiak Island Borough	Kodiak Island	100%	0%		4.85	65.00	0.07%	34.00	19.00	1,854.00	39%	53%	46%	54%	73%	14	671.00	7,195.00	2,648.00	491.00	5,311.00	1,854.00	573.38	1.01	10,894.19	19.11
Yakutat	Yakutat City and Borough	Sitka-Hoonah-Yakutat	100%	0%	0.53	7.36	564.00	0.61%	343.00	231.00	1,116.00	33%	60%	46%	54%	74%	172	435	4,916	1,786	318.00	3,630.00	878.00	372.39	0.48	86,022.29	111.87
Port Alexander	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	100%	0%		5.57	73.00	0.08%	81.00	24.00	1,258.00	31%	77%	54%	46%	44%	11	448.00	4,920.00	83.00	324.00	3,599.00	-5.00	390.67	0.02	9,376.13	0.46
Point Baker	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	100%	0%		5.35	0.00	0.00%	0.00	0.00	1,258.00	31%	77%	54%	46%	44%	0	454.00	5,058.00	-43.00	332.00	3,739.00	-126.00	397.60	-0.04	0.00	0.00
Port Protection	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	100%	0%		5.35	14.00	0.02%	41.00	14.00	1,258.00	31%	77%	54%	46%	44%	6	454.00	5,058.00	-43.00	332.00	3,739.00	-126.00	397.60	-0.04	5,566.36	-0.52
Whale Pass	Prince of Wales-Hyder Census Area	Ketchikan-Prince of Wales	100%	0%		4.75	85.00	0.09%	94.00	46.00	1,258.00	31%	77%	54%	46%	44%	20	432.00	4,722.00	-331.00	313.00	3,456.00	-315.00	376.98	-0.15	17,341.26	-6.75
Tenakee Springs	Hoonah-Angoon Census Area	Sitka-Hoonah-Yakutat	100%	0%	0.84	4.77	113.00	0.12%	222.00	98.00	1,260.00	35%	68%	51%	49%	53%	52	479.00	5,447.00	-811.00	350.00	4,021.00	-673.00	416.26	-0.34	40,793.25	-33.07
Chenega	Chugach Census Area	Chugach	100%	0%	0.61	8.09	58.00	0.06%	41.00	22.00	1,838.00	35%	54%	44%	56%	87%	19	700.00	7,865.00	1,003.00	530.00	6,050.00	966.00	605.43	-0.45	13,319.53	-9.80
Tatitlek	Chugach Census Area	Chugach	100%	0%		5.00	40.00	0.04%	69.00	17.00	1,838.00	35%	54%	44%	56%	87%	15	724	8,257	-4,587	547.00	6,336.00	-3,703.00	625.54	-1.86	10,634.17	-31.58

[GHG Emission Reduction Spreadsheet, Community Breakdown tab]

Sub-Region	Communities in the Sub-Region	Average Electricity Price ($/kWh)	Average Oil #1 Price ($)	Population	% of total CPRG focus population	Housing Units	Occupied Housing Units	# Homes Fossil Fuel Heat	% Fossil Fuel Heated Homes in CPRG area	Average Efficiency-weighted Heating Fuel Savings (gal)	Average Efficiency-weighted Annual GHG (MTCO2)	Target % Increase in 5 years	#homes at % allocation	# Heat pumps at Cost incentive 1	# Heat pumps at Cost incentive 2	# Heat pumps at Cost incentive 3	Total # Heat Pumps	Funding Allocation	Funding Allocation %	GHG (MTCO2e) 2025-2030	GHG (MTCO2e) 2025-2050
Juneau	Juneau	$0.12	$4.55	31,700	34.05%	14,100	13,000	8,142	33.0%	551.1	5.5	30%	2,443	244	733	1,466	2,443	$12,336,000.00	40.00%	67,705	338,523
Ketchikan-Prince of Wales	Ketchikan, Saxman, Coffman Cove, Craig, Hollis, Hydaburg, Kasaan, Klawock, Naukati, Thorne Bay, Edna Bay, Hyder, Metlakatla, Kake, Port Alexander, Point Baker, Port Protection, Whale Pass	$0.26	$5.26	13,612	14.62%	6,957	5,541	2,807	11.4%	448.4	4.1	25%	702	70	211	421	702	$3,545,000.00	11.49%	14,384	71,920
Sitka-Hoonah-Yakutat	Sitka, Gustavus, Pelican, Angoon, Hoonah, Klukwan, Yakutat, Tenakee Springs	$0.41	$5.56	11,126	11.95%	5,967	4,534	2,514	10.2%	464.7	4.1	25%	629	63	189	377	629	$3,177,500.00	10.30%	12,784	63,920
Petersburg-Wrangell	Petersburg, Kupreanof, Wrangell	$0.14	$4.64	4,879	5.24%	2,853	2,163	787	3.2%	534.5	5.1	30%	237	24	71	142	237	$1,198,000.00	3.88%	6,055	30,273
Haines-Skagway	Haines, Skagway	$0.26	$4.71	2,111	2.27%	1,364	961	513	2.1%	500.8	4.7	30%	154	15	46	93	154	$775,500.00	2.51%	3,608	18,038
Chugach	Valdez, Cordova, Whittier, Chenega, Tatitlek	$0.37	$5.63	6,743	7.24%	3,497	2,737	2,386	9.7%	611.5	4.2	25%	597	60	179	358	597	$3,016,000.00	9.78%	12,418	62,089
Kenai Peninsula	Seward, Homer, Port Graham, Seldovia, Nanwalek	$0.25	$5.67	9,286	9.97%	9,490	7,653	6,051	24.5%	637.5	3.1	15%	908	91	272	545	908	$4,585,500.00	14.87%	14,181	70,906
Kodiak Island	Kodiak, Port Lions, Larsen Bay, Old Harbor, Ouzinkie, Akhiok	$0.41	$4.85	5,999	6.44%	2,565	1,988	1,454	5.9%	573.4	5.4	30%	437	44	131	262	437	$2,208,000.00	7.16%	11,886	59,430
CPRG Region Totals				**85,456**			**38,577**	**24,653**		**546.6**	**4.5**		**6,107**	**611**	**1,832**	**3,664**	**6,107**	**$30,841,500.00**		**143,020**	**715,098**

Budget Region									
Juneau	2,443	244	733	1,466	2,443	$12,336,000.00	40%	67,705	338,523
Southeast (SE)	1,722	172	517	1,033	1,722	$8,696,000.00	28%	36,830	184,150
Southcentral (SC)	1,942	195	582	1,165	1,942	$9,809,500.00	32%	38,485	192,425

Inputs:	
Heat Pump Install Cost:	$8,500.00
Cost Incentive 1 (% funded by CPRG)	100%
Cost Incentive 2 (% funded by CPRG)	71%
Cost Incentive 3 (% funded by CPRG)	47%
Allocation % for Cost Incentive 1	10%
Allocation % for Cost Incentive 2	30%
Allocation % for Cost Incentive 3	60%

Outputs	
Total Funding for Heat Pump Installation	$30,841,500.00
Total # of Heat Pumps:	6,107
Total GHG Emission Reduction (MTCO2e) 2025-2030	143,019.58
Total GHG Emission Reduction (MTCO2e) 2025-2050	715,097.88
Cost Effectiveness ($/MTCO2e)	$215.65

Heat pump yearly install target breakdown						
% of BP total:	14%	20%	26%	22%	18%	Totals
	Year 1	Year 2	Year 3	Year 4	Year 5	
JUNEAU	342	489	635	537	440	2443
$4,000	205	294	381	322	264	1466
$6,000	102	147	191	161	132	733
$8,500	34	48	64	54	44	244
	Year 1	Year 2	Year 3	Year 4	Year 5	
SE	241	344	448	379	310	1722
$4,000	145	206	269	227	186	1033
$6,000	73	103	134	114	93	517
$8,500	24	34	45	38	31	172
	Year 1	Year 2	Year 3	Year 4	Year 5	
SC	272	388	505	427	350	1942
$4,000	163	233	303	256	210	1165
$6,000	81	116	152	128	105	582
$8,500	27	39	51	43	35	195

[GHG Emission Reduction Spreadsheet, Subregion Breakdown tab]